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## THE PRICE OF COPPER.

During 1907 the copper exported from this country reached the value of over $100,000,000, and this occurred in spite of a sharp fall in price. The export price for copper in December, 1907, was 13.3 cents per pound, whereas in 1906 it was no less than 24.4. Hence, the total value of the copper exported in December, 1907, no less than 82,000,000 pounds, was only three and a half million dollars in excess of less than half that quantity, or 34,000,000, sent abroad in the corresponding month of 1906. These are certainly notable and extreme fluctuations, emphasizing the fact once more that export values must be read in the light of the quantities sent out. It will, of course, be interesting to see how far such low figures as those of present quotations can go in stimulating foreign demand. The electrical market for copper, whether abroad or at home, waits, of course, upon the conditions of trade; and while copper may stiffen in value, no great hardening of prices can be expected until the great electrical industries are again humming with full activity. We trust and expect that will come soon, but meantime the price of copper looks inviting.

## THE INFLUENCE OF VOLTAGE-VARIATIONS ON THE CANDLE POWER OF INCANDESCENT LAMPS.

It has long been known that the mean horizontal candle-power of an incandescent lamp, when plotted on logarithm paper as ordinates against terminal volts as abscissas, gave a substantially straight-line graph, the inclination of the straight line varying with different types of filament. This means that the candle-power of a lamp varies substantially as a certain power of the voltage at its terminals. An article on this subject, abstracted in the Digest, has recently appeared in the *Elektrotechnische Zeitschrift* from Mr. F. Hirschauer. The article analyzes certain tests on incandescent lamps with filaments of carbon, tantalum, osmium and tungsten in addition to the Nernst lamp. The results showed that the candles varied as the tenth power of the voltage in the Nernst lamp, as the 6.3 power in the carbon, 4.3 in the tantalum and as the fourth power in osram and in tungsten lamps. Consequently, for each 1 per cent variation of voltage near the normal, the candles would change 10 per cent with the Nernst, 6.3 per cent with carbon, 4.3 per cent with tantalum and 4 per cent with osram and tungsten lamps. The same kind of inquiry in America, with the lamps we have in the market here, have shown that for 1 per cent of terminal voltage variation near the normal we get a variation in candle-power of 5.5 per cent with carbon, 5 per cent with graphitized carbon, and about 4 per cent with tantalum and tungsten.

The general conclusion to be drawn from the observations reported in the paper is that the more recent metallic filaments are not only more efficient than carbon filaments in transforming electric energy into light, but they are also more stable in luminous intensity considering accidental changes in voltage between the distributing mains. The reason for the greater

sensibility of carbon-filament lamps to voltage variation seems to be at least mainly due to the fact that whereas carbon filaments either fall in resistance or only rise very slightly as the voltage is increased near the normal, the resistance of metallic filaments tends to rise distinctly—about 0.6 per cent for 1 per cent increase in voltage. In other words, if the resistance behavior of all incandescent filaments in regard to terminal voltage were the same, we might expect the rate of increase of candles per volt to be nearly the same for all filaments. The rate of diminution in the resistance of Nernst filaments with respect to voltage is greater than that of carbon, and metal filaments have the opposite tendency. If a filament were found which increased 5 per cent in resistance for 1 per cent increase in voltage, it should give constant candle-power.

## Westinghouse.

It is a matter of profound pleasure to all interested in the welfare of the electrical industries to note how rapidly the Westinghouse situation is righting itself. As one looks back, the vista to last October shortens up, and it is seen how superficial, in a sense, the embarrassment of the moment was seriously as its pinch was felt temporarily. We are now glad to note that the receivership of the Westinghouse Lamp Company has been terminated this week, and the property turned back to the officers and stockholders. At this rate, very few traces are left of the troubles of four months ago, and the recovery has been more quickly effected than seemed possible even to the most sanguine observer. Courage and tenacity under adverse circumstances have brought this about, and no one is more heartily to be congratulated than Mr. George Westinghouse himself, who has relaxed neither nerve nor endeavor in confronting problems before which men of lesser calibre would have succumbed. The Westinghouse industries and their spirit of advance and progress have been among the foremost factors in the modern American industrial triumph, and they cannot be spared from the resources of the country. In whatever field they operate, and such fields are chiefly electrical, they are getting into shape to share brilliantly in the renaissance of prosperity now not very far away.

## Effect of Early Rising.

Sumptuary legislation will go a long way, and of late has made some rather spectacular outbursts, but we doubt whether any of it of recent date is quite so interesting to central station managers and others engaged in electrical development as a bill introduced in the British Parliament "to promote the earlier use of daylight in certain months of the year." History records the standing still of the sun to accommodate a certain warrior who needed an extra hour or so to get all his killing done, but usually mankind has tried to adjust its work and play to the hours of sunshine. This new piece of legislation appears to be both humanitarian and utilitarian in its object. It embodies a definite scheme, that of advancing the clock 20 minutes on each of the four Sundays of April. The author of the bill asserts that the saving in daylight during the six summer months subject to the action of the measure would be just about 700 hours. By going to work earlier, the artisan would acquire command of long afternoons for recreation or study and moreover "in artificial light alone the scheme would save $10,000,000 yearly" in England.

Visionary and amusing as such a scheme is, there lie elements of common sense back of it, and we are all of us too apt to assume that the present régime of late going to bed and late rising will always prevail. Should we revert gradually to the healthier régime of our forefathers, largely that of the farm where it still prevails in spite of cheap kerosene, that will have been attained by the slow process of custom and fashion at which this English bill aims. We can also imagine a time coming when with the coal of the world near exhaustion such a bill, or one even more stringently Rooseveltian in its definition of crime against society, may forbid any kind of liberal use of light after dark or after dawn. In those days the lighting companies will only be happy that have cultivated a day load of power business. But, seriously, such times of depression as we have lately gone through, tending to cut down consumption of electrical energy at night, show how insensibly and automatically people become economical of light without being forced into it by direct arbitrary legislation.

## Is the Arc Doomed?

The coming of the present high-efficiency incandescent lamps raises very forcefully the inevitable question regarding the status of the arc lamp in the future. The matter is a very serious one because of the large investment in arc equipment now carried by the central stations and the certainty of its loss in large part if the arc is generally abandoned. Of one thing there is reasonable certainty—that the so-called commercial arc service, using 75 volts or so at the lamp out of 110 to 120 at service wires, is already on the down grade of obsolescence. However good as an illuminant the arc may be, the waste of energy is so prodigious as to cut down the practical efficiency woefully. If one takes the other horn of the dilemma and uses alternating arcs, he is little better off since the arc itself is at a disadvantage. No one but an American would seriously consider throwing away one-third of his energy at the start in order to save a relatively small amount of labor, as is evidenced by the small progress made by the enclosed arc abroad. That the saving in labor is relatively small in many instances there is good reason to believe, although in operation on a large scale the cost of energy comes down enough to show a saving as over the Continental practice of burning two or sometimes three open arcs in series.

We are aware that some of our readers will hold up their hands in horror at this mention of open arcs, but unless all the signs of the times are wrong, the enclosed arc in anything like its present form cannot survive the attack of the modern incandescent, though it will have a moderate respite so long as its rivals are held up to present prices. The solemn truth to tell, the cost of trimming open arcs was much exaggerated during the exploitation period of the enclosed arcs. Perusal of the discussions at the conventions of the N. E. L. A. will show that in the hands of skilfully managed companies open arcs were often trimmed at a very modest figure annually, in some cases little above $5 and often below $10. Of course, the old open arc has nearly disappeared, but the new arcs, which alone are fitted to cope with the tungsten and similar lamps, are practically in the open class. The flaming arcs of the kind now common have the same short life of carbons, but improvements are being rapidly made and if the price of the electrodes falls to a reasonable figure, as it soon must, the labor and cost of trimming will not be so serious an item as it now seems. The new arcs of the magnetite class or so-called "luminous" arcs

have much longer life of the electrodes, but need considerable care as yet to keep the globes in condition.

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The new arcs materially change the situation. Basing comparisons on mean spherical candle-power, they are about three times as efficient as the tungsten lamp. When a tremendous flood of light is needed they are there with the goods. It seems improbable that they will not be materially improved over their present form in various ways, leaving them in still better condition for competition. It looks therefore as if so far as economy is concerned the new arcs have a bigger advantage over the new incandescents than did the old arcs over the old incandescents. In fact, one could in the matter of illumination come pretty near to beating out the commercial enclosed arc with carbon filaments. The arc when properly screened had much the advantage in color, however. At present the tungsten lamp has made a great improvement in color value, but is still behind the best arc illumination. The new titanium arc is admirable in color, and even the yellow flaming arc is less objectionable than the violet enclosed arcs at small current. It is very gratifying that with the improvements in the incandescents, the arcs have moved forward at an even pace. For there is a genuine use for big units of light, a use that will expand as the general plane of lighting is raised. Most streets are to-day only half lighted and the tendency should steadily be toward a considerably larger volume of light, so to speak. To give this with economy in fixtures and with enhancement of the general effect of brilliancy, powerful units are needed, which cannot yet be furnished with incandescent lamps. But this much is certain, that the whole matter of street lighting has been opened wide for reconsideration. Save for the enclosed arc, changes have heretofore been few, while to-day with scant warning one is confronted with half a dozen startling possibilities which demand immediate consideration.

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## STANDARD PERFORMANCES OF ELECTRICAL MACHINERY.

A valuable paper has recently been presented before the Institution of Electrical Engineers, in London, by Dr. R Goldschmidt (abstracted in the Digest), on standard performances of electrical machinery, the keynote of which is the torque of such machines. The matter is somewhat disguised and befogged in the treatment, because the standard of reference in the paper is the kilowatts per thousand revolutions per minute, and this is called "power"; whereas it is not actually power but power divided by angular velocity, and, therefore, equal to a torque. The unit of torque thus selected is 9.55 megadyne-decimeters in the metric system, or 7.04 lb.-feet in the British system, or the torque which a weight of 7.04 lb. avoirdupois at the latitude of London establishes about a shaft axis when acting over a pulley of one foot radius. This torque develops a power of one kilowatt per 1000 r.p.m. It is easily shown by the relations of the C. G. S. system of units that in any direct-current machine the product of total useful megamaxwells, to as well as from the armature from all poles, times the number of thousands of armature wires, times the average amperes flowing in each wire will be six times the torque generated when measured in the above unit. If the machine is a generator, the torque developed must therefore be the product of kilo-ampere-wires and total flux in megamaxwells, divided by six, when expressed in the unit selected by the paper. In other words, if kilo-ampere-wires are written $AW$, and megamaxwells flux by $F$, then $AWF \times 0.1667$ is the torque of the generator expressed in units of 7.04 lb.-feet. In the case of any direct-current motor, the torque developed will correspond precisely with this formula; but the usefully available torque or delivered torque, will be less, since the total mechanical and magnetic friction torques within the motor must first be deducted. In the paper, the numerical constant for direct-current machines is given as 0.165, which agrees with the above theory within 1 per cent.

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In the case of a single-phase synchronous machine, the same law of torque applies at any particular instant, but the resultant average torque developed is the arithmetical mean; whereas the current is expressed in terms of its square-root of mean square. For sinusoidal currents, at unity power factor, we should, therefore, have $AWF \times 0.15$ as the torque in units of the paper, and with a power factor of less than unity a correspondingly smaller numerical constant. The constant given in the paper is 0.145 for single-phasers. The advantage of the particular unit of torque given in the paper is that it is obtained directly by dividing the power of the machine in kilowatts by its angular velocity in kilo-revolutions per minute the speediest computation that our sexagesimal time units will probably admit of. If we consider the torque of different successive sizes of any type of machine, we may divide the triple product $AWF$ into two terms, namely, the ampere-wires $AW$ and the flux $F$. There is no necessary ratio between these two terms, so far as the formula expresses the relation. As the machines get larger, we might conceivably have the ampere-wires constant and the total flux in megamaxwells increasing in direct proportion to the torque developed; or we might go to the other extreme, and suppose that as the torque developed in successive machines increased, the flux might be the same, but the ampere-wires of the armature advance progressively.

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In either of the above extreme cases, the ratio of ampere-wires to total interlinked flux would vary in successively larger machines. The middle position of constant ratio between ampere-wires and total interlinked flux would require that each of these similarly increased in successive sizes of machine. This would require either or both to increase as the square root of the torque developed. The curve of either ampere-wires, or of total flux, plotted as ordinates against machine torque would be a parabola, having its axis on the axis of abscissas. The paper indicates in a very interesting way, taking presumably the analysis of many actual machines into account, that this is substantially the fact, the curves given being nearly parabolic. It was pointed out in the discussion to the paper that there was by no means always in practice a constant ratio between ampere-wires and total megamaxwells. Nevertheless, the paper is a useful contribution to our knowledge of dynamo analysis in bringing out the fact that as the torque increases in successively larger dynamos, the increase occurs uniformly, or nearly so, both in ampere-wires and in flux. It would be interesting to have the corresponding analysis made out for American machines. A large number of curves accompany the paper. Two only of the figures are reproduced in our digest. One of these gives the parabolic relations already referred to and the other gives the efficiencies of transformers with different frequencies. The limit indicated of 97 per cent at 50 cycles per second is distinctly less than is obtained in large sizes in America, where 98.7 per cent has been reached at rated load.

## N. E. L. A. Chicago Convention.

A meeting of the executive committee of the National Electric Light Association was held at the office of the association, 29 West Thirty-ninth Street, on Thursday, Feb. 20, at which the details of the Chicago convention, May 19 to 22, were taken up and discussed. The following members of the committee were present: Mr. Dudley Farrand, president; Mr. W. C. L. Eglin, first vice-president; Messrs. Arthur Williams, Charles L. Edgar, Charles R. Huntley, Louis A. Ferguson, Frank M. Tait, A. J. DeCamp and W. W. Freeman, secretary. Messrs. Frank H. Gale and Walter Neumuller presented the plans of the exhibition committee, which were approved. A number of important matters bearing upon the work of the association were considered, and much satisfaction was expressed regarding progress made in various ways since the last meeting.

The decorations in booths in the exhibition hall will be designed and furnished by D. H. Burnham & Co., the well-known firm of Chicago architects, which had charge of the recent Chicago Electrical Show. Already many applications for exhibition space have been received by the committee. This year it is decided to allow the manufacturers to have charge of the exhibition rather than the central-station men. Further details will be announced later. Mr. Frank H. Gale, of the General Electric Company, is the chairman of the committee; Mr. H. M. Post, of the Western Electric Company, is treasurer, and Mr. Walter Neumuller, of the New York Edison Company, is secretary.

## Opening of the Hudson River Tunnel.

The first of the Hudson & Manhattan Railroad Company's tunnels under the Hudson River was formally opened to the public on Feb. 25. The part of the route now opened consists of a twin-tube tunnel extending from Hoboken, N. J., to Sixth Avenue and Nineteenth Street, New York, a distance of nearly three miles. This section of the tunnel system is generally designated as the Morton Street or uptown tubes.

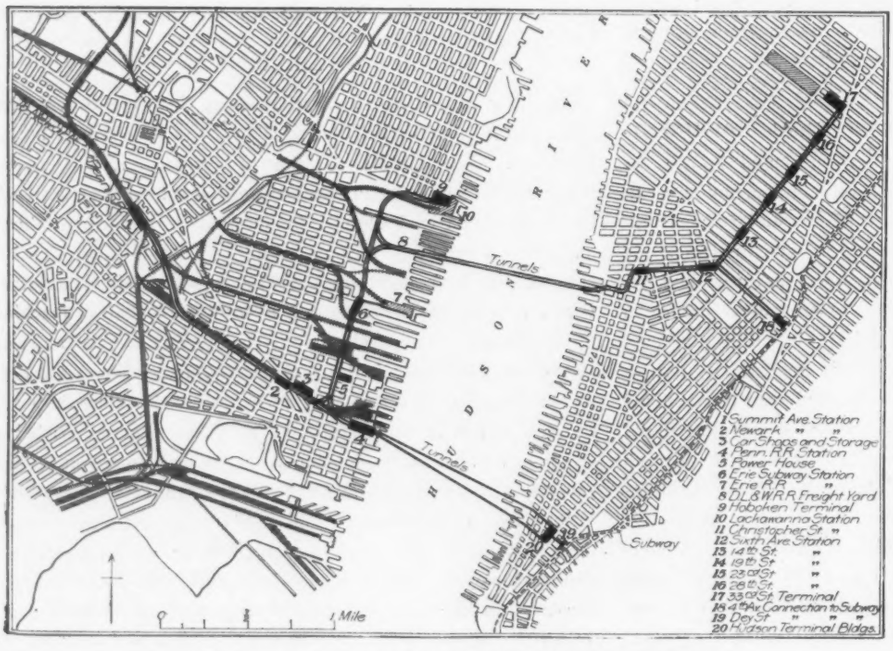



FIG. 1.—MAP OF ROUTE OF COMPLETED TUNNEL SYSTEM.

Passenger stations in Manhattan will be located as follows: Christopher and Greenwich Streets, where connection will be made with the Ninth Avenue elevated line; Christopher Street and Sixth Avenue, where connection will be made with the Sixth Avenue elevated, and in Sixth Avenue, at Fourteenth, Nineteenth, Twenty-third, Twenty-eighth and Thirty-third Streets. For the present trains will run only to Nineteenth Street and Sixth Avenue. At the Hoboken terminal connection is made with the Delaware, Lackawanna & Western Railroad,

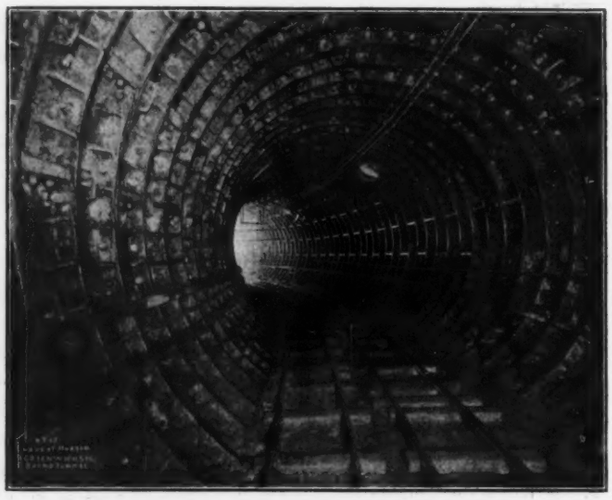


FIG. 2.—INTERIOR OF TUNNEL, SHOWING STEEL RINGS BEFORE BEING COVERED WITH CONCRETE.

where passengers may descend directly to the tunnel cars without leaving the station.

Eight-car trains, electrically propelled, are used in the tunnel. The cars are made entirely of steel, and are constructed upon a plan differing materially from any others now used in the Metropolitan district. They have large, sliding side doors in the middle as well as at either end, and the platforms are so arranged at the terminal stations that passengers enter and leave the cars at the same time. The doors are operated by compressed air and no signal bells are used. When the last door in the train is securely closed, the motorman receives an electric flash signal and starts the train. The automatic adjustment is such that the signal to start cannot be given so long as any door in the train remains open for even the fraction of an inch.

The ventilation of the tubes is automatic, as each train acts as a piston, forcing out the air ahead of it and drawing in a fresh supply from the surface as it proceeds.

The tunnels are made of steel rings which were bolted together and set in place as the boring shield, working in compressed air opened the way for them. In most places the steel rings are covered with a coating of concrete, so that the interior of the tunnel is smooth. The interior diameter of each tube is 15 ft. 3 in. The two tubes are entirely separate from each other, and are about 30 ft. apart for the greater part of the distance under the river.

There are four sections to the tunnel system. Section one, the part just described, is known as the north tunnel. Section two is the south tunnel, which is nearly completed; it extends from Cortlandt and Fulton Streets, New York, to Jersey City. The third section is a transverse tunnel running along the New Jersey shore of the Hudson, one and a fourth miles, connecting the terminal in Jersey City with that in Hoboken. The fourth section is a branch line running from Jersey City to Newark.

A 22-story structure, known as the Hudson Terminal Building, has been placed over the New York terminal of section two. From the train platform, which is two stories below the street level, one may proceed by underground and under-river routes to any part of Greater New York.

A sectional elevation of the tunnel is shown in Fig. 3, which indicates the arrangement of the third-rail and feeders. The third-rail construction is similar to that employed in the East River Tunnel of the Interborough Rapid Transit Company. This construction was designed by Mr. Hugh Hazelton, electrical engineer of the Hudson Companies, in conjunction with Mr. L. B. Stillwell, consulting engineer for both companies.

The engineering features of the present tunnel system were worked out by Mr. Chas. M. Jacobs, deputy chief engineer. The system is in reality an extension of a brick tunnel constructed for 1200-ft. under the Hudson in 1879 by Mr. D. C. Haskins, and pushed forward for 1800 additional feet 10 years later by Pearson & Son. The work has been completed by the Hudson Companies for the Hudson & Manhattan Railway Company, of which Mr. Wm. G. McAdoo is president. It is stated that the cost of the system when fully completed will be about $70,000,000.

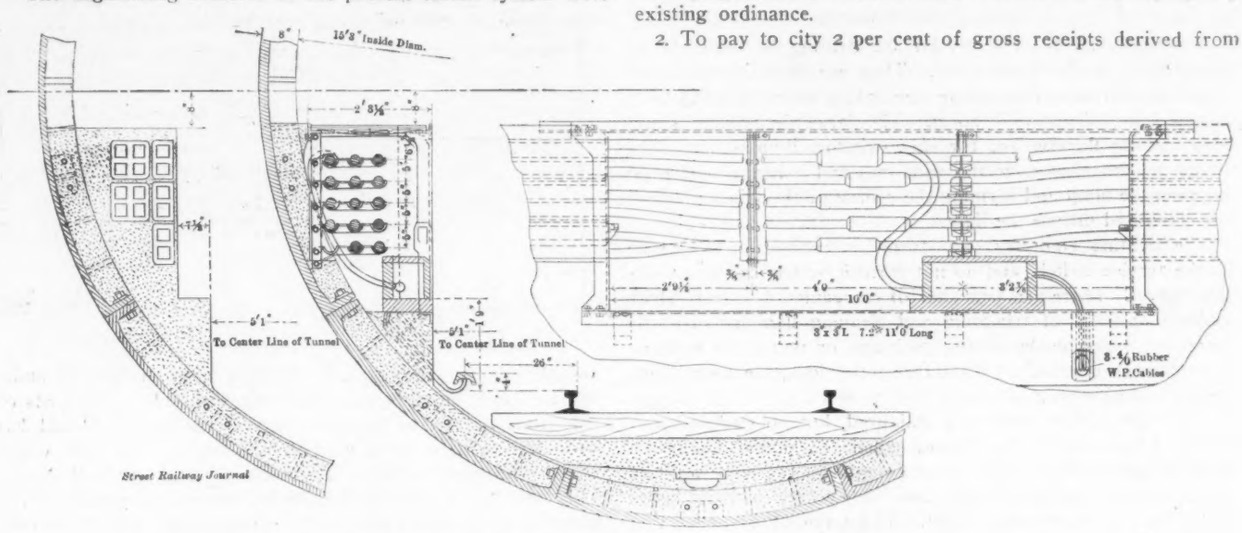



FIG. 3.—SECTION OF TUNNEL, SHOWING ARRANGEMENT OF THIRD-RAIL AND FEEDERS.

## New York City Independent Telephone Movement.

At a public hearing last week before a special committee of the Board of Estimate on telephone franchise applications, counsel for the New York Electric Lines Company made an appeal to obtain the co-operation of the city in the company's efforts to install its lines in the conduits of the Empire Subway Company. Mr. J. Aspinall Hodge, representing the New York Electric Lines Company, said that the company had contracts with 107,000 persons who would use its service if it should be installed. He asserted that the company had a franchise which had been granted by the city in 1883 and that the Court of Appeals when asked to decide the point whether or not the company had a right to build its own conduits, had handed down a decision saying that the company had a right to use the conduits of the Empire Subway Company. Mr. Hodge criticised the Empire Company, saying that it was impossible to find out from it which of its ducts were available, and charged that many ducts were filled with dead wires so that the claim could be made that they were in use.

Mr. D. A. Reynolds, president of the Electric Lines Company, said that a rate as low as $30 a year will be made for a private line or limited business service, with a rate from 2 cents to 5 cents for excess messages. For an unlimited service the rate will be from $1 to $5 a month. He said that with present suburban and allied lines the company could, at the start, put its subscribers in the city in touch with 2,000,000 outside subscribers. For a permit to operate for 25 years, Mr. Reynolds said, the Bell Company offered the city approximately $7,250,000 and the Atlantic Company $9,000,000. In a letter to the city, a summary of which is given below, the inducements of the New York Electric Lines Company are enumerated as follows:

1. On recognition of the company's right and co-operation by the city, the company promises to pay to the city in accordance with the franchise wherever it may be necessary to disturb the pavements, within 10 days after the taking up of such pavements, the maximum sum which may be required of grantees for laying electrical conduits under streets of said city by any existing ordinance.

2. To pay to city 2 per cent of gross receipts derived from rental of wires, estimated to exceed 500,000 telephones annually, up to the completion of the system of 600,000 telephones.

3. To duplicate present "Bell" system with strictly modern equipment and furnish city with first-class telephone service at one-half present rates; or if the city elects, the company will install without charge, maintain at actual cost, whatever equipment the city may desire, and furnish flat rate of 2 cents per message for all local calls.

4. To establish, maintain and operate without cost to the city under the direction of the fire department, an auxiliary fire-alarm system adapted for installation in factories, stores and dwellings, to be operated in conjunction with the company's lines and supplied to customers at actual rental, not to exceed $10 a year.

5. To establish, maintain and operate without cost to the city under police regulations, a police-call system connecting each police station with the exchange in its respective precinct, thereby placing every telephone user in the system within three seconds of the nearest police station.

The committee before which the hearing was held will report later.

## Cazin Metallic-Filament Lamps.

Three patents were granted Feb. 11 to F. M. F. Cazin relating to the manufacture of his system of metallic-filament lamps. In one patent the claims are on a filament with a primary core coated with an electrolytically deposited layer of metal alloys, the layers decreasing in affinity for oxygen from the core to the surface, which latter consists of a rare metal oxidized on its exposed side. The core may consist of carbon or other practically fusible material, which is coated electrolytically with a metal like the natural alloy osmiridium. The outer layer may be of a metal having little affinity for oxygen, such as uranium. In the claims of the second patent, it is

stated that the layer in contact with the carbon is "partly interimpregnated with the carbon" and that on the surface is coated with an oxide, all the metals having a high point of fusion, and the inner ones having more affinity for oxygen than the outer ones. The metals in contact with the carbon may be of the ruthenium-osmium class, and the outer one of the rare metal class, coated on the exposed surface with its oxide. The third patent relates to a filament which increases in thickness toward the terminals in order that these may not become unduly heated under current.

## High-Efficiency Lighting in Berlin.

By L. J. Auerbacher.

Practically all the commercial arc lighting in Berlin is accomplished by the flaming arc. They are very liberally used, some store fronts of moderate size having as many as 15 to 20 lamps, hung about 5 ft. apart. The large department stores also use the flaming arc for show-window illumination. The lamps are installed over the windows, and a heavy opal glass between the lamp and forming the ceiling of the window serves to screen and diffuse the light.

The lighting company only furnishes current and wire up to the service switch, and do not furnish or trim lamps of any description. There are a number of companies, however, which make a business of trimming and cleaning flaming arcs. As there are many blocks having 50 lamps or more, the business is said to be profitable. With rare exceptions, the lamps burn steady and give good service.

There are a few open arcs still used, but no enclosed arcs used. A new line of arc lamps called "Economy" lamps are now being installed. They operate singly on 115 volts, and are made in 4, 6, 8 and 10 ampere sizes. They burn 30 to 50 hours and give a brilliant white light. The economy is about that of an open arc.

The incandescent lighting is practically all high-efficiency. Here and there a few carbon-filament lamps are still in service. Whenever the fixtures or conditions are such that the lamp can hang in a downward position, the "Osram" or tungsten lamp is used. If lamps are required to be hung at an angle the tantalum lamp is used. Some fixtures have both types, the tantalum on angular arms and the tungsten on the vertical arms. Fixtures are now designed to have the lamps hang downward. I noticed this particularly in a new theater and in the newest department store, where only high-efficiency lamps are used.

The cost of current for lighting is 10 cents per kilowatt-hour. The company furnishes no lamp renewals. The conditions noted in Berlin are typical of all German cities at the present time. Everywhere the high-efficiency lamp, arc and incandescent, appears to have passed into regular use.

## Large Colorado Water-Power Development.

Surveys have been recently completed and rights obtained from the United States government and state of Colorado for an important water-power and irrigation project upon the Cache LaPoudre River, in Laramie County, Colorado, north of Denver.

The Cache LaPoudre River is the largest river on the eastern slope of the Rocky Mountains within the state, having a very large and important drainage area, and within a distance of 30 miles has a fall of nearly one-half mile. From the lower power house site to the headwaters of the upper reservoir the total head is 2420 ft.

Three immense reservoir sites have been determined upon. The first is located above a narrow canyon, where a dam will be constructed having a height of 200 ft, a length on top of 180 ft. and a length at the bottom of 27 ft. This reservoir will hold 1,153,630,559 cu. ft. of water.

A second reservoir and dam, just above the first reservoir, is also projected, having a capacity of 4,955,278,148 cu. ft., and a third dam and reservoir, 20 miles farther up-stream, the dam having a height of 230 ft., will impound 5,103,141,958 cu. ft. of water.

The power to be developed from these various reservoirs it is expected will be utilized in part by the Denver City Tramway Company in the operation of its city and interurban lines,

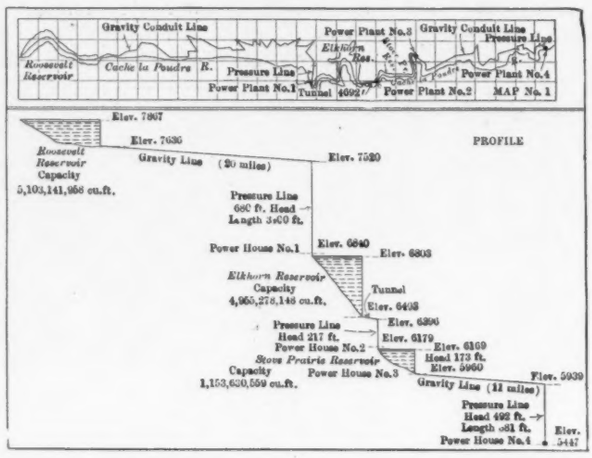



FIG. 1.—PROFILE MAP OF WATER-POWER DEVELOPMENT.

and also to pump water for irrigating a large territory of undeveloped lands in northern and eastern Colorado. Hundreds of thousands of acres of the richest land in the state, now arid, has an underflow of water at a depth of from 15 ft. to 40 ft. which may be pumped to the surface, thus making the land fertile. This land is now used principally for grazing purposes and has little value, but with water available for irrigation it will be very

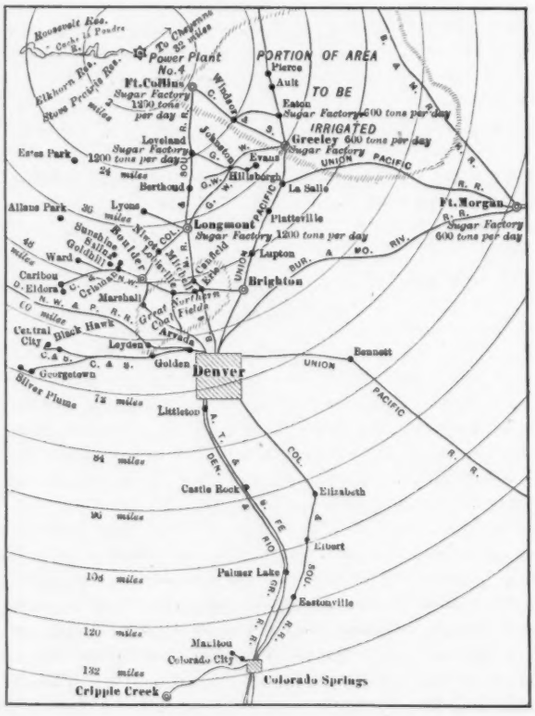



FIG. 2.—MAP OF WATER-POWER AND IRRIGATION DEVELOPMENT.

fertile and well adapted for raising sugar beets and other profitable crops. The sugar-beet crop of Colorado during the past year was valued at $17,000,000. An acre of irrigated Colorado land will produce 30,000 lbs. of sugar beets, which in turn yields 6000 lbs. of refined sugar at the wholesale price of 4 cents a pound, making $240 per acre. This land, after water is secured,

readily brings from $200 to $300 per acre, and pays a good interest on a much larger valuation. There is a rapid development in the power requirements of not only the tramway lines, for which some 70 miles of new construction is now projected, but in all branches of a great many varied industries throughout this section of the state.

The ultimate development of power in the Cache LaPoudre River will furnish upward of 100,000 horse-power, which is considerably larger than any water-power development yet planned in the state. This project is to be carried forward and completed by an organization of very strong Colorado interests.

## "Loaded" Telephone Cables in Germany.

The following table gives a list of the telephone cable lines loaded with Pupin inductance coils which have been installed by the Siemens-Halske Company, of Berlin:

| Cable. | Year of installation. | Length of cable in kilometers. | Copper diameter in mm. | Number of double wires. | Distance between successive inductance coil boxes in km. |
|---|---|---|---|---|---|
| Berlin-Potsdam | 1902 | 32.5 | 1.0 | 28 | 1.3 |
| Merida-Progreso (Mexico) | 1904 | 40. | 0.8 | 14 | 1.4 |
| Düsseldorf-Elberfeld | 1904 | 32. | 1.5 and 2.0 | 28 and 56 | 1.3 |
| Schoeneberg-Ragow | 1905 | 28. | 0.7 | 3.5 and 7 | 1.4 |
| Berlin-Spandau | 1906 | 18. | 0.8 | 56 and 112 | 1.75 |
| Berlin-Potsdam | 1906 | 40. | 0.9 | 100 | 1.4 |
| Friedrichshafen - Romershorn (submarine cable in Bodensee) | 1906 | 12. | | | |
| Berlin-Wannsee | 1907 in course of erection | 25. | 0.8 | 250 | 1.5 |
| Berlin-Köpenick | in course of erection | 17. | 0.8 | 56 | 1.6 |
| Duisburg-Mülheim-Oberhausen | in course of erection | 27. | 1.5 and 2.0 | 56 | 1.5 |

The above cables are stated to have been in uninterrupted service since their installation. With the exception of the Mexican cable, all of them are in Germany. The submarine Bodensee cable and the difficulties in laying it have been referred to in the Digest. The aggregate length of the above 10 cables is 271.5 kilometers or 168.6 miles. For lexicographers it may be of interest to know that at one place a cable loaded with Pupin inductance coils is called a "pupinized" cable.

## Public Service Dinner of the A. I. E. E.

The public service dinner of the American Institute of Electrical Engineers, held at the Waldorf-Astoria, New York City, Feb. 19, was successful from many points of view. Through the co-operation of the Commonwealth Edison Company (Chicago, Ill.), the Edison Illuminating Company of Boston, the Edison Electric Illuminating Company of Brooklyn, the Philadelphia Electric Company and the New York Edison Company, who contributed the decorations of the dining-room, and Sibley & Pitman, who furnished art-glass fixtures, the illumination of the banquet hall was in tasteful accord with the engineering idea of the proper appearance of a room for such an occasion. Miniature lamps, the circuits to which were concealed beneath the carpet, were sprinkled among the green leaves of the flowers and plants forming the live decorations of each table. The official seal of the institute, with its blue background and outlined in golden yellow lamps, with white lamps for the letters, occupied a commanding position over the speakers' table. The souvenirs included miniature lamps arranged as stickpins and plaster casts of the institute seal. Regret was expressed on all sides at the inability of two of the announced speakers, Mr. Theodore P. Shonts and Dr. C. P. Steinmetz, to attend the dinner, owing to illness.

President H. G. Scott, of the institute, who acted as toastmaster, read a telegram of cordial greetings from Governor Hughes, and announced that arrangements are under way for a political economy meeting of the institute in the near future.

The first speaker was Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Company, who responded to the toast "The Ethics of Public Service." Mr. Kerr said that the public server must be compelled to serve well. "The strongest impelling force is the hope of gain. Fortunately, bad service never pays in the long run and good service stands a fair chance of profit. The spirit of service is unselfishly doing something that does some one else good. It always pays, and when this spirit is sufficiently cultivated, then those who wish to yield public service will be given full, fair and right opportunities to do it."

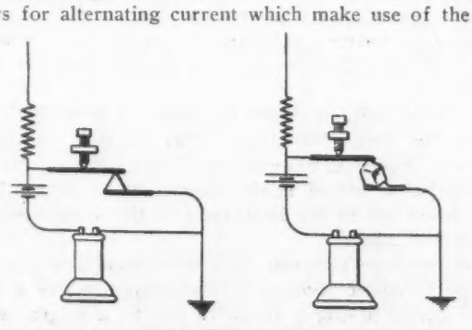
Mr. Frank W. Stevens, chairman of the Second District Commission, of New York, spoke on the subject of "State Control of the Public Service Corporations, Past and Present." He treated the subject historically, and limited his remarks to conditions in New York state. The first law relating to railroads was passed in the year 1826. Although it was recognized from the outset that steam transportation must be under the control of the state, the legislation previous to 1846 was tentative in nature. In this year the constitution of the state provided that the chartering of all such corporations as railroads must be done by general law. In 1883 a railroad commission was appointed for serving in an advisory capacity. Beginning with July 1, 1907, the Public Service Commission, with law-making power, has been in control. The commission is not designed to manage the business of corporations, but to stop abuses, and to secure equal rights to all mankind under its supervision.

Mr. Chas. R. Huntley, of the Buffalo General Electric Company, had as his subject "The Electric Lighting Companies and the Public." He said that the public, not knowing the essential details of the production of electrical energy, may have come to look askance at public service companies, while the companies, in turn, may have been more reticent to discuss the details in the face of malicious criticism. The purpose of the Public Service Commission is to protect the people from any injustice on the part of the companies, and the companies from any injustice on the part of the people. When the parties concerned mutually understand the full facts most of the troubles that now harass the electric companies will be at an end. Mr. Huntley said he had since 1895 favored the idea of such commissions, but for a long while stood almost alone in this respect among central-station men.

Mr. T. Commerford Martin responded to the toast "The Technical Press and the Public." He stated that the one aim of the technical journal is to cultivate the truth, and to give the facts, and it serves the interests of both its readers and the public by telling its readers how to improve its service to the public. It is a great misfortune that the technical press cannot reach a larger proportion of the general public in order to correct the injury done by the daily "yellow press" to the public utility corporations, and more particularly to the technical staffs which serve them. The public is already becoming weary of the insult that has been heaped upon the electrical developments of the last 25 years. A turning point has been reached, and under the new régime with public service commissions the public utility companies will receive a more cordial treatment.

## Alternating-Current Rectifiers.

Three patents granted Feb. 11 to Mr. G. W. Pierce described rectifiers for alternating current which make use of the asymmetrical conductivity of various substances. In one patent which relates to the use of rectified alternating current with uni-



FIGS. 1 AND 2.—PIERCE WIRELESS TELEGRAPH DETECTOR.

directional ammeters, the inventor states his preference for carborundum as the asymmetrical conductor. In a second patent which relates more particularly to detectors for use in wireless telegraphy, the substance employed as an asymmetrical conductor is the oxide of titanium. The crystal is cut out on a plane substantially at right-angles to its axis, and one of the electrodes is engaged with a point or corner of the crystal so that a small area of contact is secured. It is stated that when the substance is placed as shown in Fig. 1 it is highly sensitive as a detector of electromagnetic waves. In Fig. 2 a similar arrangement is indicated where telluride of silver is used as the asymmetrical conductor. The use of the latter substance for this purpose is covered by the third patent issued to Mr. Pierce.

## CURRENT NEWS AND NOTES.

*INCANDESCENT LIGHTING.*—Mr. John W. Lieb, Jr., associate general manager of the New York Edison Company, will discuss this subject on March 6, at 8:15 p. m., before the Electrical Engineering Society of Columbia University, in Room 301 of the Engineering Building of the University.

*PURDUE EXCURSION.*—About 250 students of the civil, electrical and mechanical engineering department of Purdue University will make an inspection trip to Chicago and other cities where industrial and electrical plants will be thrown open for their inspection and study. The trip will be made about the first week in April.

*FOREST PRESERVATION.*—A special meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineers' Building, Thursday evening, March 5, 1908, at 8 o'clock, when Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, will deliver an illustrated lecture on forest preservation. This lecture will be open to the public, and tickets will not be required.

*STEAM IN THE STEAM TURBINE.*—The March meeting of the American Society of Mechanical Engineers will be held on Tuesday evening, March 10, at 8:15 o'clock in the Engineering Societies Building. The meeting will be addressed by Dr. Charles P. Steinmetz, member A. S. M. E.; past president A. I. E. E. and professor of electrical engineering Union University, the subject being "The Steam Path of the Steam Turbine."

*LONDON ELECTRICAL SUPPLY.*—The total electrical energy supplied in London during the past year was 213,174,379 kw-hours. Of this amount the municipal authorities supplied 28,281,320 kw-hours for power and heating; 42,934,965 kw-hours for private lighting, and 16,578,716 kw-hours for public lighting. The private companies supplied 38,006,198 kw-hours for power and heating, 82,995,205 kw-hours for private lighting, and 4,377,875 kw-hours for public lighting.

*NEW YORK CITY DEBT.*—At the present moment, when there is still so much clamor for municipal plants of one kind and the other, New York City is issuing long-time bonds to meet current running expenses. Such a policy of financial suicide could not endure very long and it is not surprising therefore that the State Legislature is proposing the appointment of a committee to investigate the subject of the city debt, the present limit of which it has been proposed to sweep aside so that the city can plunge deeper. The obligations of the city are selling to-day on about a 6 per cent basis, and stand no higher than those of first-class public utility corporations.

*ELECTRIC SUPPLY IN LONDON.*—The English Board of Trade has issued a report on the use of electrical engineering in the London metropolitan area, in 1907. The municipal authorities supplied 28,281,320 units for power and heating, 42,934,965 units for private lighting, and 16,578,716 for public lighting, the cost per unit, respectively, being 1.301d., 3.677d. and 1.850d., a total of 87,795,001 units supplied at an average cost of 2.563d. The companies were responsible for the supply of 38,006,198 units for power and heating, 82,995,205 for private lighting and 4,377,875 for public lighting, charging for such supply 1.45d., 3.833d. and 1.62d. per unit, respectively, altogether 125,379,278 units supplied at an average cost of 3.034d. per unit. From these figures it appears that London's total supply of electricity was 213,174,279 units, costing 2.839d. per unit.

*BRANLY WIRELESS TORPEDOES.*—M. Branly, to whose invention of the coherer wireless telegraph owes its origin, has taken up the subject of the wireless control of torpedoes. While experimental torpedoes have been made for wireless control, they have been impracticable owing to being subject to interference from sources of Hertzian waves other than that of the controlling station. M. Branly has obviated this fault by the invention of a system whereby the torpedo apparatus is only influenced by Hertzian waves emitted by the transmitting apparatus with which it is in special connection. He has not, he says, invented the control of mechanism at a distance, as this has been done by others. "There is, however, one new object which my apparatus attains. It removes this control from other influences. The advantage is that freedom is obtained from accidental or voluntary perturbations which might have been produced by others. That is all."

*WIRE INSPECTION.*—The Underwriters' Laboratories, Chicago, announces that after extended conferences with the representatives of manufacturers of rubber-covered wires and cords, and following notices sent all manufacturers utilizing the services of the Wire Inspection Bureau, affiliation with that bureau has been withdrawn, and its reports will not be accepted after Saturday, Feb. 29. Stamps or labels issued by the Wire Inspection Bureau and attached to rubber covered wires, or cords after Saturday, Feb. 29, should therefore not be recognized as having been affixed under the supervision of the Laboratories, representing insurance interests. The announcement further states that during the progress of negotiations resulting in the action reported above, inspection departments, users and manufacturers have requested the inauguration of a system of testing, inspecting and labeling insulated wires and cords at factories which would receive the endorsement of the Laboratories, and the conduct of such a service, along the lines established by the Laboratories for a number of other industries, is under consideration.

*ELECTRICITY AND LIFE.*—Last week, according to Marconi wireless advices to the *New York Times*, Dr. Louise B. Robinovitch, of New York, presented a remarkable paper before the French Biological Society on a new method of resuscitating animals apparently dead from electrical shock. Miss Robinovitch, whose methods of electrical anæsthesia have already attained wide attention in France, after a long series of experiments on rabbits, dogs and other animals, has reached the conclusion that the cases are rare where the victims cannot be recalled to life. Her method differs from that of Dr. Leduc and other French experts in that she places the cathode, or negative pole, near the spinal column, and the anode over the kidneys, and gives the patient a series of rhythmic electrical impulses, thus restoring respiration and the cardiac reaction, and the animals which to all intents and purposes were perfectly dead come to life. When treated thus resuscitation is said to be very rapid. The same treatment has been successfully applied where the subject has been suffering from a syncope produced by chloroform. A friend of Dr. Robinovitch states that she would shortly make application to competent authorities in New York for permission to apply her system of resuscitation to the next murderer put to death by electricity.

*ELECTRICITY AND MULES.*—The Comstock Lode has adopted electricity for haulage, and among the mules displaced are said to be 12 which have been underground for 30 years, not having seen the light of day during that period.

*TWENTY-MILLION-DOLLAR SAN FRANCISCO TERMINAL.*—Plans have been prepared for a $20,000,000 union transportation terminal for San Francisco, to be used by electric traction surface and subway lines, as well as steam lines for freight and passengers.

*MR. THOMAS A. EDISON,* on Sunday, Feb. 23, underwent an operation at the Manhattan Eye, Ear and Throat Hospital, New York, owing to the development of an acute abscess in the left middle ear. The operation was successful and the patient will only be detained at the hospital for a few days.

*"BLACK HAND" USES THE TELEPHONE.*—The Italian criminals who have been practising the Neapolitan and Sicilian system of blackmail in this country are having recourse to the telephone in their operations. In a recent case in New York City, the arrest of a blackmailer was followed by telephonic messages to the family of one victimized threatening to kidnap the children, burn the house and kill the husband.

*EIGHT-HOUR TELEGRAPHERS.*—Acting under the advice of their general attorneys, the railroads of Texas have agreed to ignore the new State eight-hour-day law affecting the employment of telegraph operators. An operator has complained to the State's attorney and a fight in court over the new law is to be precipitated.

*THE SUBWAY CAR.*—With this title a pamphlet has been issued containing a part of the report by Mr. B. J. Arnold upon the New York City subway, made to the Public Service Commission. Included is an analysis of the various types of cars adapted to subway work, accompanied by drawings of the cars. The conclusion of Mr. Arnold is that the present car, when provided with additional side doors located near each end, or four in all, will best meet the conditions of the present subway and will permit a marked increase in the capacity and comfort of travel. The report, which is dated Feb. 18, supplements a preliminary report by Mr. Arnold dated Nov. 26.

*TELEPHONIC AMENITIES.*—The Nebraska Telephone Company, of Omaha, has granted to its new rival, the Independent Telephone Company, the right of connecting up with its fire alarm system. General Manager Belt, of the first-mentioned company, said that while it had a contract with the city for supplying this service and could, if so desired, stand on its lawful rights and withhold the service from competitors and their patrons, it felt that there were larger interests to be served and safeguarded than those of any corporation; and that his company had always operated on the principle that a public corporation is a public servant and that the best service to the greatest number of people was a motto that ought to commend it to the people at large.

*ILLUMINATING ENGINEERING IN SALOONS.*—At Dubuque, Ia., a clever piece of illuminating engineering has been done by some saloon keepers to nullify the practical effect of a recent law requiring that saloons have no screen or partition of any kind between the bar and the front window. The plan is to place several arc lamps near the front of the saloon with reflectors which throw the light forward toward the window. The result is that anyone looking into the saloon is partially blinded by the glare of these lamps, and as the bar is in shadow as compared with the front end of the saloon, it is difficult to see who is in the saloon. It remains to be seen whether Iowa lawmakers will recognize and prohibit this method of producing the practical effects of a screen without having a material partition of any kind.

*LONG ISLAND RAILROAD ELECTRIC LINES.*—Plans have been made for the equipment of the lines of the North Shore Division and between Jamaica and Long Island City. The equipment has been purchased for the Northern Division of the road east of Whitestone Junction, and work will be finished the present year. The Jamaica station will be the terminal for steam trains from the central and southern sections of the Island, and passengers will change here to electric trains operating through Long Island City to the Pennsylvania station in New York and also to Flatbush trains for transfer to the Battery tunnel line. Lines now equipped for electric service include the main branch from Flatbush Avenue to Belmont Park, with a loop from Ozone Park to Rockaway, Valley Stream and Jamaica. The plans of the Long Island Railroad also contemplate the electric equipment of all lines in Queens County. The total immediate expenditure involved is $12,000,000, and it is expected that all work laid out will be completed within three years.

*THE PASSING OF THE STEAM LOCOMOTIVE.*—Mr. Wilson E. Symons presented a paper on "The Passing of the Steam Locomotive" before the Western Society of Engineers Feb. 19. He took the position that although electric locomotives would be used in the future in densely-populated districts, the extension of railways into districts now sparsely populated would call for a steadily-increasing number of steam locomotives. The increase in population which is sure to take place in the United States would call for a great increase in the number of both steam and electric locomotives, an increase in the number of tracks on trunk lines and the canalizing of our principal waterways to take care of the traffic. Mr. Peter Junkersfeld, chairman of the meeting, called attention to the interesting fact that all the passenger trains now operated within the city limits of Chicago could be moved by a power station of 50,000-kw capacity. It would call for only part of the capacity of the largest electric power station now in Chicago —that of the Commonwealth Edison Company at Fisk Street. He thought there must certainly be some economical advantage in such a method of operation.

*TORONTO SECTION A. I. E. E.*—After a luncheon at the St. Charles, at which some 25 members of the section and their friends were present, the Toronto section of the American Institute of Electrical Engineers held its regular February meeting at the rooms of the Engineers' Club, 96 King Street West, in conjunction with the club, many of whose members were present. Over 50 attended. After the formal business of the evening, the chief item of which was the presentation and carrying of a motion requesting the board of directors to take up the matter of the subdivision of the associate group of the membership, the technical subject for the evening was taken up. This involved a paper presented by Mr. Walter S. Moody, of the Schenectady section, who treated very thoroughly the subject in hand, namely, "Feeder Regulators." Mr. Moody, the well-known designing engineer with the General Electric Company, took up the history of the attempt to regulate the voltage of feeders in distributing and transmitting systems. He indicated the lines of development of this apparatus from the earlier resistance methods of control in the case of direct-current circuits to the most recent automatic induction type of alternating-current regulator. He then discussed at considerable length the latter type of regulator, showing its field of operation, its mechanical characteristics, and indicating some of the successful installations with records of their performance. The address was very fully illustrated by means of lantern slides, and at its close a number of inquiries were made of Mr. Moody concerning the features which he had touched upon and a considerable discussion followed.

*EIFFEL TOWER WIRELESS APPARATUS BURNED.*—Ten thousand dollars' worth of wireless telegraph apparatus, part of the equipment on the Eiffel Tower, Paris, was destroyed by fire Feb. 18.

*CHICAGO ELECTRIC RAILWAY CONSOLIDATION.*—It is reported that a movement is on foot to merge into a single system under practically one management all electric railways entering Chicago. The plan includes the construction of a subway to the shopping district.

*WIRELESS TELEGRAPHY IN GERMANY.*—A bill now receiving the consideration of the Reichstag at Berlin provides that wireless telegraph stations on board ships and on shore may be erected and operated only with the sanction of the imperial government.

*INLAND WATERWAYS CONFERENCE.*—President Roosevelt has invited the presidents of the American Institute of Electrical Engineers and other professional bodies to be present in May at the conference in Washington of State governors on the subject of inland waterways.

*ELECTRIC IRONS AT GRINNELL, IOWA.*—The Grinnell Electric & Heating Company now has 312 electric irons in service among its customers. Grinnell has a population of about 5000. The irons have been sold to customers at the rate of about 100 for each summer season since they began to be introduced.

*TOLSTOI'S GIFT TO EDISON.*—Count Leo Tolstoi will send to Mr. T. A. Edison a phonograph cylinder bearing several interpretations of Gospel texts, spoken in English. Some time ago Mr. Edison sent the great Russian author a phonograph, together with a letter expressing his high regard for him, and requesting a phonographic record of his voice.

*CONSTITUTIONALITY OF THE NEW YORK PUBLIC SERVICE COMMISSIONS.*—A decision last week by the New York State Court of Appeals in a case upon an appeal from the old State Commission of Gas and Electricity indicates that the same court will uphold the constitutionality of the act authorizing the present public service commissions should an action on that subject come up before it.

*OHIO RATE REGULATION.*—A bill has been introduced in the Ohio Legislature to give city councils power to regulate the prices of electric light and gas. A bill which proposed to place the regulation of telephone rates in the hands of city councils has been indefinitely postponed in committee. Independent telephone companies, it is said, favored the state plan through representatives who appeared before the committee.

*CONTROL OF WIRELESS.*—In the House of Representatives at Washington, on Feb. 21, Mr. Sheppard, of Texas, introduced a bill making it a punishable offense to originate or transmit a false wireless message purporting to be official; to break in and interfere with any wireless station while it is transmitting an official message; to refuse to cease or fail to cease sending a private wireless message when called upon to do so by an operator having an official message to be sent.

*NEW SOUTH WALES TROLLEY PLANT.*—A correspondent of Sydney, New South Wales, has sent us further particulars relating to the new plant of the New South Wales Government Electrical Tramways. The direct-current portion of the power station consists of four 850-kw, 550-volt General Electric direct-current generators, driven by Allis-Chalmers horizontal engines; the alternating-current portion of the station consists of three 1500-kw, 6600-volt, 25-cycle General Electric three-phase generators driven by Allis-Chalmers cross-compound engines. A 1750-kw Parsons turbine unit has also been installed and orders have been placed for two Parsons 5000-kw turbine units.

*A PROGRESSIVE NEW JERSEY CENTRAL STATION.*—In three years the Lambertville (N. J.) Heat, Light & Power Company has increased the number of its customers to 208 from 85. In that time the plant has been rebuilt, a 24-hour circuit installed and lines extended to New Hope to furnish electrical service for the streets and the residents of that town. Notwithstanding the expense entailed in renovating the plant, dividend payments began last year. The general manager is Mr. H. M. Morehead, who deserves in no small degree the credit for transforming a dilapidated plant into a paying proposition.

*OHIO MUNICIPAL OPERATION.*—The Ohio House of Representatives has passed the Shuler bill, which gives cities the right to operate electric light and natural gas plants and sell the product for private use. A proposed amendment providing that municipal plants should not fix their charges at a figure less than cost failed of adoption. This was supported by the private lighting interests, as they feel that cities should not have the right to operate plants at public expense for the benefit of those who purchase the current or gas. The bill, it was claimed, would enable cities to drive lighting and power plants out of business at any time and substitute the public service. The Senate may take up some of these matters.

*NEW YORK OVERHEAD WIRES.*—The New York Central Railroad Company has denied the jurisdiction of the Commission of Water Supply, Gas and Electricity of New York City with relation to the transmission of electricity for all purposes within the limits of the city of New York, or to the construction of electrical mains, conduits, conductors, subways and the erection of poles for the transmission of electricity. This position was taken by the railroad officials in relation to an order for the railroad company to remove its overhead transmission poles and conductors on its right of way along the Harlem River to the city line. It was also held in the reply that the Public Service Commission has no power in the matter at issue.

*WHITE MOUNTAIN WATER POWER.*—The U. S. Department of Agriculture in a recent report gives a statement of the water-power from the watersheds forming the White Mountain region of New England. It has been estimated that the capital invested in the manufacturing enterprises utilizing the power of streams originating in these watersheds amounts to $250,000,000. The water-power at present supplied by the Connecticut River and its tributaries amounts to 140,000 horsepower, and all of the power available has not yet been developed. The amount of power in the Saco River is stated to be very large, but its value is not given. No less than 180,000 horse-power is stated to be used along the course of the Androscoggin River.

*BOVEY GOES TO ENGLAND.*—It is understood that Prof. Henry T. Bovey, dean of the faculty of applied science at McGill University, is to retire, having been appointed to the rectorship of the Imperial College of Science and Technology, an institution which has been some time in formation in London, and which will affiliate and direct the several technical institutes of that city, besides building and equipping new college headquarters at South Kensington, as a training place for the whole empire in post-graduate work. Dean Bovey will not teach, although eminently successful in that direction, but will be given a great opportunity to display his ability, already well tested as an administrator. McGill and technical education in Canada owe a great deal to him, and he will be sorely missed by a host of friends and admirers in the Dominion and the United States.

## Combined Central-Station and Water-Pumping Plant.

AT Pine Bluff, Ark., a city of about 20,000 inhabitants, a new central station will shortly be completed for the Equitable Securities Company, under the design and direction of Ford, Bacon & Davis, consulting engineers, of New York. Combined with this central station will be the pumping equipment of the city water works. The plans for the plant illustrate a progressive scheme of development, as is shown in the accompanying drawing, Fig. 2, which is a general floor plan of the power house as it will be when completed. The equipment shown in dotted outline represents future alternators, and the present installation is shown in solid lines.

The power house is a brick-and-steel structure designed for an ultimate length of about 243 ft., and a maximum width of about 116 ft. It is located at the intersection of Plum Street and Fourth Avenue, about 75 ft. east of the city's water reservoir; from this reservoir water will be obtained for boiler feed and condensing purposes, as well as for drinking and commercial service. The present length of the power house is about 110 ft., the width being the same as in the final completed structure. The plans provide for an ultimate installation of six batteries of boilers, aggregating 6000 horse-power, the boilers being set two in a battery. The present installation will consist of two batteries of 300-hp boilers, aggregating 1200 horse-power, the future boilers to be of the same rating. The plant is designed with all boiler fronts in a single row, allowance for the space requirements of the larger boilers being made by building the blow-off trench at the rear with an offset of 2 ft. The first installation of boilers will be handled by a sheet-iron stack 80 in. inside diameter by 125 ft. high, located in the center of the boiler room between the two 600-hp batteries. The boiler room extends at present to a length of about 91 ft., its width being 48.5 ft. inside.

The stack is mounted on a concrete foundation built in five octagonal courses. Each course is 2 ft. high, the top course being 15 ft. in width, and the bottom course 21 ft. in width. The length of each face of the top course is 6.5 ft., each of the bottom faces being 9 ft. long. The sheets of the stack vary in width from 62 in. to 70 in., the thickness being from 3/16 in to 3/8 in. A clean-out door, 30 in. wide and 6 ft. high, is constructed at the bottom of the stack. The opening from the breeching on each side is 6 ft. 6 in. high by 38 in. wide, the bottom being 14 ft. 6 in. above the floor line.

Each boiler at present installed is a Babcock & Wilcox unit of water-tube type, with 140 4-in. tubes, three 54-in. steam drums, a 2½-in. blow-off valve, and hand-fired grate 8 ft. 6 in. long by 7 ft. wide. The space occupied per battery is 21 ft. 10 in. by 21 ft. 7½ in. The furnace for each boiler discharges into a breeching connecting each battery directly with the stack. Each uptake is 102 in. long by 33 in. wide. The breeching is 38 in. wide throughout, but the height inside varies from 35 in. at the further furnace on each side to 6 ft. 6 in. at the stack.

Space is provided behind the first stack for two Webster 1200-hp open heaters, one of which will suffice for the first installation. The heater is provided with an 8-in. exhaust-steam inlet, with a grate-valve attachment, a 2-in. cold-water inlet, a 3½-in. overflow outlet, and a 5-in. outlet to the feed pumps, with 2-in. drain pipe. The heaters, which are guaranteed to raise the temperature of the feed water from 40 deg. to 210 deg. Fahr., will be located on a platform 15 ft. 5 in. above the floor line, as illustrated in Fig. 2. This platform is tied to the roof truss of the boiler room by angle-irons and is supported upon steel columns. In the plans space is provided in the boiler room for two additional stacks, 110 in. in diameter and 175 ft. high; one stack will be placed between each pair of 1200-hp boiler batteries. The blow-off tank for the present, and also for the completed installation, is located in a pit behind the boilers. It is 3 ft. in diameter and 5 ft. long, and is served by a 4-in. line which collects the blow-off steam from all of the boilers as it passes through the blow-off trench. A 6-in. vent is joined to the blow-off tank.

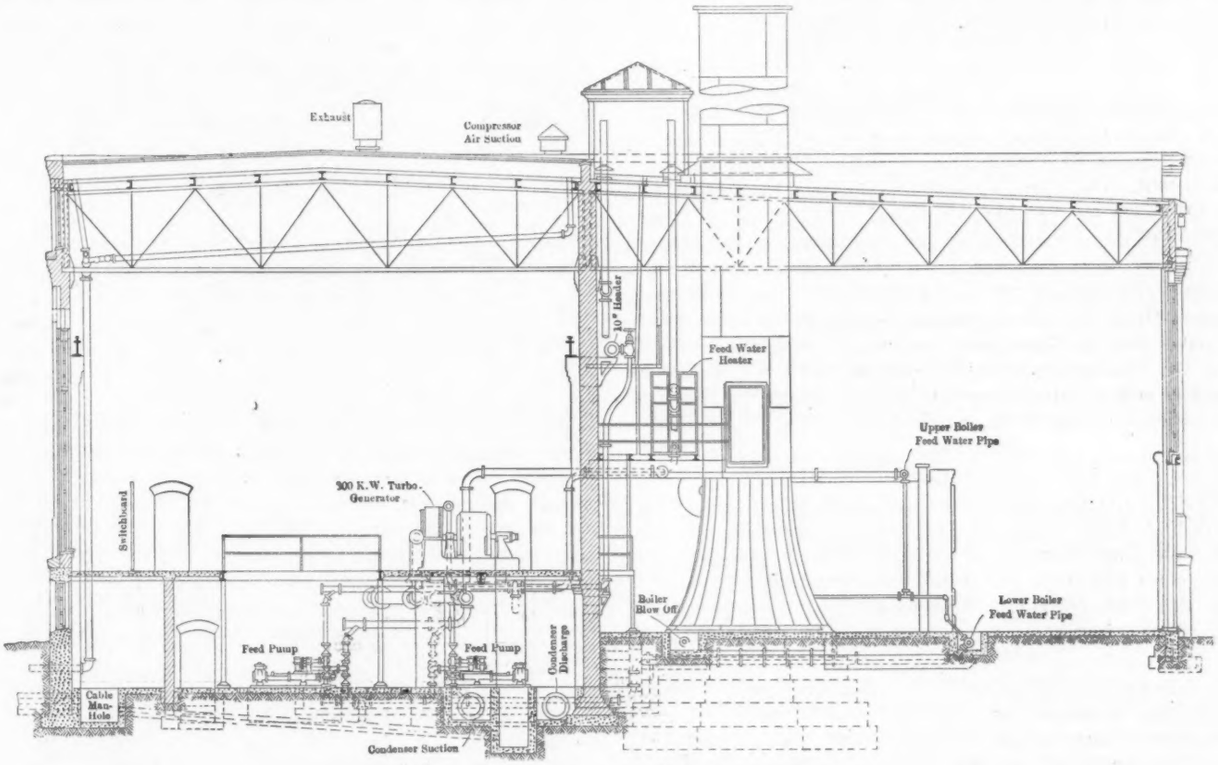



FIG. 1.—CROSS-SECTION THROUGH GENERATOR ROOM.

A general cross-section of the plant is shown in Fig. 2. The boiler room is separated from the machinery section by a 24-in. fire wall. At present the electric generating equipment occupies a room 44 ft. x 45 ft., and the water-works pumping apparatus occupies a separate space 60 ft. long and 64 ft. wide. The

present generator room contains two 300-kw horizontal Curtis turbines driving General Electric alternators, a six-panel switchboard 13 ft. long and an engine-driven exciter set. Each generator is a 2300-volt, four-pole, revolving-field machine built with two bearings, and designed to deliver three-phase, 60-cycle current, the speed being 1800 r. p. m. Each turbine is supplied with steam through a 4-in. pipe and exhausts through a 20-in. outlet. The height of each turbo-generator is 7 ft. 6 in., its extreme length 10 ft., and width 6 ft. 3 in. The turbines are placed 12 ft. apart on centers. Space is available for three additional units of higher rating in the completed room, as shown in Fig. 2, and also for two motor-driven exciter sets and three rotary converters or motor-generator sets.

The reservoir for the water supply is capable of holding 3,000,000 gal. It is built of reinforced concrete, 240 ft. long by 154 ft. wide, with a maximum depth of 15 ft. 6 in. Two deep wells, which have been driven on the reservoir site, are operated by air-lift pumps. To supply the necessary pneumatic pressure, two Laidlaw-Dunn-Gordon cross-compound Corliss two-stage compressors have been installed at the power plant. The high-pressure steam cylinders of these compressors are 17 in. in diameter, and the low-pressures 32 in.; the air cylinders are 30 in. and 18 in. in diameter, and the common stroke is 36 in. Each compressor is equipped with a fly-wheel 14 in. in diameter, having an 8-in. face, a 12-in. suction pipe, 6-in. discharge pipe, 6-in. steam supply, and 12-in. exhaust outlet. Water is drawn from the reservoir through a 30-in. suction pipe. Space is provided in the pump room for two compressors of similar design, as the plant is enlarged.

Opposite the compressors are the Worthington triple-expansion pumps which force the water through the city mains and services. The high, intermediate and low-pressure cylinders are respectively 10 in., 16 in. and 25 in. in diameter; the water cylinders are 17 in. in diameter, and the common stroke is 24 in. Each pump has an 18-in. suction and 16-in. water delivery pipe, a 2½-in. steam line and a 7-in. exhaust line. The floor space per pump is 23 ft. 1 in. x 6 ft. 9 in., and the height above the floor, 11 ft. Four more similar service pumps can be installed in the extended pump room. The boiler feed-pumps are of the Blake duplex type, 7½ in. x 5 in. x 10 in.

At this writing the contract has not been awarded for the condensing equipment in connection with the turbines, air compressors and service pumps, but the piping is arranged so that whatever may be the make of condensing apparatus installed, the suction and discharge piping arrangements will be satisfactory. The 30-in. suction main from the reservoir is provided with bell-and-spigot lateral pipes for the future service pumps, with a special three-way flanged lateral pipe for connection with the existing service pumps, and compressors. Provision will be made for the supply of injection water from this main to jet condensers which will probably be installed in the basement beneath the steam turbines. Provision will be made to operate the apparatus non-condensing, if desired.

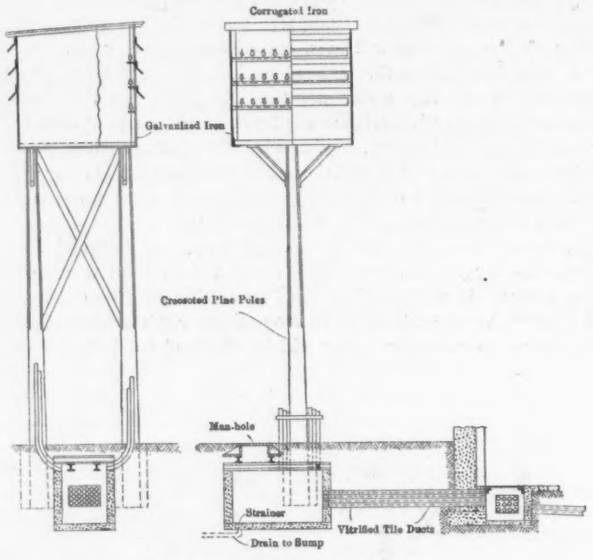



FIG. 3.—DISTRIBUTING POLE BOX.

The condenser suction header is mainly an 18-in. line, which runs from the flanged three-way lateral mentioned above through the basement, cutting through the compressor foundations and passing between the turbine foundations to a central flanked delivery point at the latter site. Blanked flanges are provided below the compressors for the attachment of the condenser injection line connections. Similarly an 18-in. condensing water outlet pipe passes horizontally through the basement, and thence to the reservoir, this outlet pipe being provided with flanges for the reception of condensation discharges.

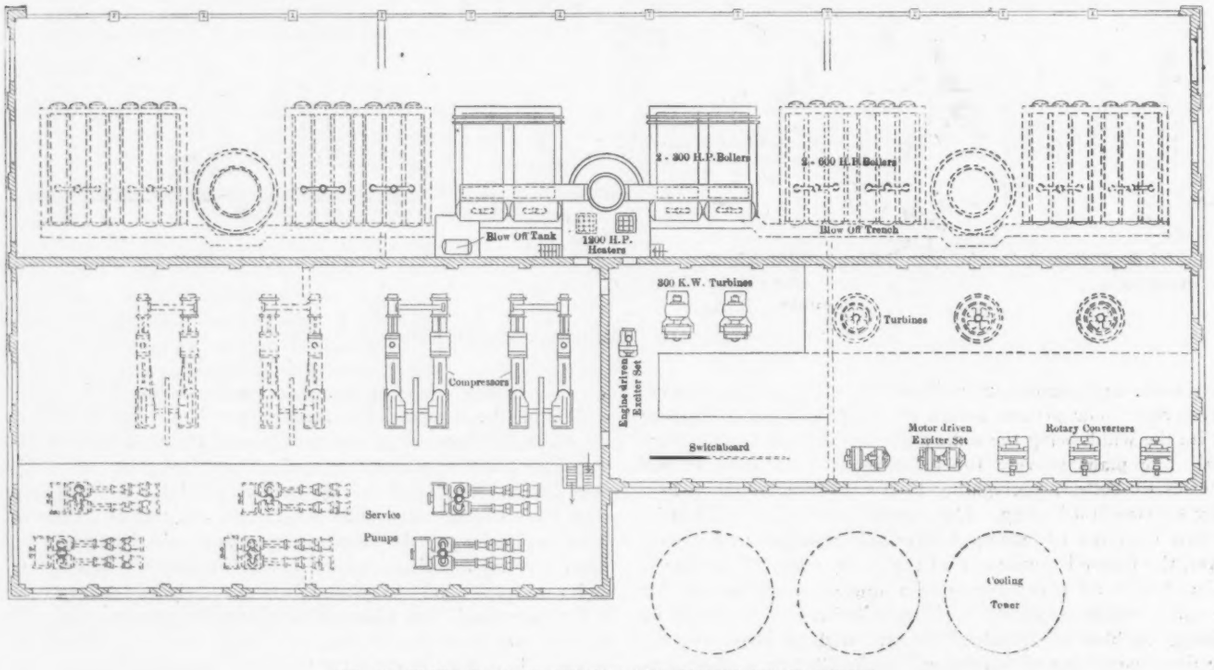



FIG. 2.—FLOOR PLAN OF PRESENT AND FUTURE POWER HOUSE.

It is probable that at some time in the future a cooling-tower installation will be made at the plant, and the piping plans provide for discharge and suction connections with any future cooling-tower system.

The live-steam piping is simple in arrangement. Each boiler supplies steam to a 10-in. wrought-iron header running horizontally through the boiler room about 24 ft. above the floor. The steam-delivery outlets are 6 in. in diameter, each being controlled by a valve at the boiler and just before they join the header. From the main header two 4-in. steam lines drop down to the turbine-room floor level, pass beneath it and rise to feed the turbines. A 4-in. pipe or auxiliary header supplies steam to the boiler feed-pumps, sump pumps, etc. Each air compressor is supplied with steam through a separate 6-in. pipe line from the main header, and the service pumps receive steam through separate 3-in. pipes. Special care was taken to avoid crippling any piece of machinery by the failure of any other machine or any supply line. The auxiliary exhaust steam is passed through the feed-water heater in the usual way. A double feed line conveys water to the boilers from the feed pumps, the pump mains being cross-connected and provided with valves to give the maximum flexibility.

Two sets of 2300-volt, three-phase busbars are provided, and any generator or feeder can be thrown at will upon either set. Automatic tripping devices are provided on the oil-switch relays. There are three feeder panels, one station and two turbine panels. An oil-switch is included in each main generator circuit, and selector knife switches effect the transfer from bus to bus. The busbars, selector switches, oil switches and auxiliary transformers are located in the basement. The switchboard proper is placed 5 ft. 2 in. from the wall. The cables are carried beneath the floor in vitrified tile ducts. Fig. 3 illustrates the cable ducts and distributing pole details. The cables from the turbo-alternators pass to a 5 ft. x 3 ft. pit below the switchboard in 4-in. pipe conduits. A cable trench with floor outlets extends beneath the switchboard from the pit, and the outgoing lines leave the station by conduits that are branched into 2½-in. pipes outside the building, the latter being carried up two 32-ft. creosoted pine poles to a corrugated iron cable terminal box, 10 ft. square and 10 ft. high, located at the tops of the poles. Inside this box cross-pieces are set horizontally, with insulators 12 in. apart on centers, and louvers beneath which the feeder lines are run horizontally to their various distribution points.

## A Transmission Line Considered as a Mechanical Structure.

By W. T. Ryan.

ALTHOUGH the line is the weakest portion of almost every energy transmission system, it usually receives less attention from the designer of the system than any other part. Considered as a conductor the question of proper proportioning of the line and its bearing on the general efficiency of the plant of which it is a part, generally receives very careful consideration. The electrical difficulties which may appear on the line and the consideration of the line as a mechanical structure are usually treated as of secondary importance.

The purpose of this article is to present the equations, which are made use of in the mechanical design of the line, in such a form that with certain data and a reasonable allowance for practical considerations one can at once find the deflection to be allowed in the wires, diameter of pole, bending moment of the force to be counteracted by guying at curves, and finally the variation in heights of poles on grades in order that the tension on the poles produced by the wires may remain in equilibrium.

When a wire is suspended freely between supports it takes a curve known in mechanics as a catenary.

The exact solution of the properties of this curve is very tedious, but for small deflections such as are encountered in transmission wires, use may be made of the parabola, which approaches very closely to the catenary and is a very simple curve to compute.

The relation between the length $l$, the deflection $d$, and the tension $T$ on a wire at $A$ or $B$ (Fig. 1), as a factor of its weight is expressed by the formula,

$$T = \frac{l^2 w}{8d} \qquad (1)$$

$l$ = length of span in feet.
$d$ = deflection in feet.
$w$ = weight of wire (+ insulation and an assumed coating of ice) in pounds per foot.
$T$ = tension on wire in pounds.

Transposing equation (1)

$$d = \frac{l^2 w}{8T} \qquad (2)$$

The tension on the wire at the ends of the span $AB$ would be increased by an amount equal to $wl$ due to the weight of

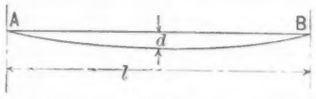



FIG. 1.—DEFLECTION OF WIRE BETWEEN POLES ON LEVEL.

the wire. This quantity is such a small portion of the total tension that it may be neglected without introducing any appreciable error

When in use wire is subject to serious mechanical stresses due not only to its weight plus its additional coating of ice, but also to variations in tension caused by change of temperature and wind pressure. The difficulty due to temperature effects is taken care of by using as the deflection $d$ in equation (2) the minimum deflection, or, in other words, the deflection to be allowed in the coldest weather. The length of the wire $L$ for a span of length $l$ and a deflection $d$ is obtained from the formula,

$$L = l + \frac{8d^2}{3l} \qquad (3)$$

Knowing the length of the wire $L'$ for the minimum temperature, its length $L''$ at any desired temperature can be determined by the formula,

$$L'' = L'\,(1 + B\,(t - t')) \qquad (4)$$

$B$ = temperature coefficient of linear expansion.
$t$ = temperature at which it is desired to determine the deflection $d$.
$t'$ = minimum temperature to which the line is exposed.

It is to be remarked at this point that instead of using the coefficient of linear expansion given in the usual text-books in physics and mechanics (.0000095 per deg. F. for copper) from one-third to one-half of this value is here used, depending principally upon the degree of hardness of the material of the wire. Some of the wire manufacturers have made experimental determinations of this coefficient by suspending a wire between supports whose distance apart was known and observing the sag at a number of different temperatures. The value of the linear temperature-expansion coefficient of copper thus obtained was only from one-third to one-half the usual value. If $B$ is taken as .0000047 for copper wires one will be on the safe side and still have a fairly accurate solution. The deflection $d_t$ at the temperature $t$ will then be given by the formula,

$$d_t = \sqrt{\frac{3l(L'' - l)}{8}} \qquad (5)$$

The wind pressure will be considered as acting at right angles to the direction of the wire, since the maximum tension is produced by a wind which is at right angles to the direction of the line. The pressure $P$ per lineal foot on a wire is given by the formula,

$$P = .05\ p\ D_w$$

$P$ = pressure in lbs. per lineal foot.
$D_w$ = diameter of wire in inches.
$p$ = normal pressure of the wind in lbs. per sq. ft.

$p$ is usually taken at about 30 for its maximum value in the open. This corresponds to a wind velocity of 90 miles per hour. Where the force of the wind is broken by buildings, trees, etc., 20 would be a better value. By substituting in the above formula, the effect of the pressure in pounds per lineal foot of the wire is given at once. This pressure combines with the weight of the wire at right angles, hence the resultant stress per foot, which will be designated as $W$, is,

$$W = \sqrt{w^2 + P^2} \qquad (7)$$

$w$ = weight per foot of wire + insulation + ice.

$P$ = stress in pounds per foot due to wind.

The minimum deflection in feet is now given by the formula,

$$d = \frac{l^2 w}{8T} \qquad (8)$$

The stresses sustained by a pole may be classified under three heads, as follows: (1) Weight of wire (+ insulation + ice). (2) That produced by tension in the wires (varies with configuration of the line both as regards direction and elevation). (3) Wind (upon wires, poles, cross-arms, etc.).

Stress (1) is a compressive force, (2) and (3) produce flexing strains. The weight of the wire, ice, etc., produces on the poles simply a compressive force which can be neglected, inasmuch as poles which are strong enough to withstand the bending stresses to which they are subjected are not perceptibly affected by this slight compression.

The pole is treated as though it were a beam rigidly fixed at one and loaded at the other end. The resisting moment $M$ is

$$M = \frac{SI}{C} \qquad (9)$$

$S$ = stress in section.

$I$ = moment of inertia of section.

$C$ = distance from center to fiber under maximum stress.

The moment of the force applied to the top of the pole is $W'h$ where $W'$ is the total tension in the wires (in pounds) and $h$ is the height of the pole (in inches).

For a circular pole section having a diameter $D$ (in inches), $I = \pi D^4 \div 64$ and $C = D \div 2$. Substituting these values in equation (9),

$$W'h = \frac{SI}{C} = \frac{S\pi D^4 \div 64}{D \div 2} \qquad (10)$$

Substituting for $S$, $\frac{T_m}{n}$ where $T_m$ = tensile strength (in pounds per square inch) of the material in the pole and $n$ = factor of safety,

$$W'h = \frac{T_m \pi D^3}{32n}$$

$$D = \sqrt{\frac{32W'hn}{\pi T_m}} \qquad (11)$$

Now, from equation (1)

$$T = \frac{l^2 w}{8d} = wl\left(\tfrac{1}{8}\frac{l}{d}\right) \qquad (12)$$

or, in other words, $T = K$ (weight of wire + insulation and ice), where $K$ is a constant and equal to one-eighth the span divided by the deflection at the center.

$$Pt = .05\ pDwlN + \frac{.05pD''h'}{2} \qquad (13)$$

$Pt$ = total stress in pounds due to wind.

$p$ = maximum pressure due to wind in pounds per square foot, say, 30.

$Dw$ = diameter of ice-laden wire in inches.

$l$ = length of span, in feet.

$N$ = number of wires.

$D''$ = average diameter of pole, in inches.

$h'$ = height of pole above ground, in feet.

The stress due to wind pressure on the pole acts along the whole length of pole, hence it has the same effect as though one-half of its force were concentrated at the top. (The slight stress produced by the wind striking against the cross-arms and insulators is neglected.)

$$W' = \sqrt{(NT)^2 + Pt^2} \qquad (14)$$

The bending moment due to an angle in the line, which is to be counteracted by guying is $2W' \cos \frac{a}{2}$, where $W'$ is the stress as determined above, and $a$ is the angle made between the wires at the turn.

The diameter of the pole obtained by the above formula is, of course, the maximum diameter, or the diameter of the pole just above the ground. In order to determine how this diameter should compare with the diameter at any other point, consider again that the pole is a beam rigidly fixed at one end and loaded at the other. If the pole has a round cross-section and tapers toward the top, it is a truncated cone and should have a parabolic section in order that the least material should be used for the maximum strength. If the pole is round a section of it would then be a cubic parabola, and the diameter at the ground should be 3/2 the diameter at the top.

In the above the poles have been assumed to be of equal length, a constant distance apart, and on level ground. When the tops of the poles are no longer in line, and are different distances apart, unbalanced stresses will be encountered unless special precautions are observed in the erection.

Consider first the case where the pole line is level, with the poles set at unequal distances. Since the tension produced in the poles by the wires varies with the sag in the wires, it is at once obvious that the tension can be kept in equilibrium in unequal spans by varying the deflection of the wires in the spans of unequal length.

Where the pole tops are no longer level it is to be observed that since the wire in any span is everywhere in equilibrium as regards tension in the wire, it may be tied to a pole at any point intermediate between its ends without disturbing its

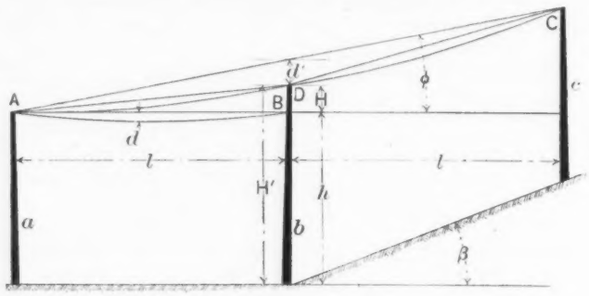



FIG. 2.—DEFLECTION OF WIRE BETWEEN POSTS ON SLOPE.

equilibrium in any way. It should also be borne in mind that it is a change in grade and not the grade itself that is of chief importance.

In order to find an assumed span $AC$, Fig. 2, with the correct deflection for maintaining an equilibrium of tension on the pole $a$, it will be assumed that the poles $a$ and $b$ are on level ground and that $c$ is on an up-grade.

The deflection $d$ in the span $AB$ is

$$d = \frac{l^2 W}{8T} \qquad (15)$$

The deflection $d'$ in the assumed span $d'$ is $\frac{(AC)^2 W}{8T}$. Since the spans are assumed to be of equal length an appreciable error will not be introduced by substituting $2l$ for $AC$. The equation for $d'$ then becomes $d' = \frac{(2l)^2 W}{8T}$ (16)

If the pole $b$ be made of such a length that the span $AC$ will be anchored to it at a point $D$ which lies upon its natural curve between $A$ and $C$, the equilibrium of the tension in the wire will not be disturbed.

From the figure it is seen that,

$$H = l \sin \phi - d' \text{ (very closely)} \qquad (17)$$

but from equations (15) and (16)

$$d' = 4d$$

and,

$$\sin \phi = \tfrac{1}{2} \sin \beta$$

hence,

$$H = \tfrac{1}{2} l \sin \beta - 4d \qquad (18)$$

Therefore, the height of the pole $b$, which is designated as $H'$ is

$$H' = h + \tfrac{1}{2} l \sin \beta - 4d \qquad (19)$$

where

$h$ = normal height of poles.
$l$ = length of span.
$d$ = normal deflection allowed.
$\beta$ = angle of change in grade.

If the spans are of unequal length the solution will be the same except that the deflection in the assumed span $AC$ will be more or less than four times the normal deflection $d$; and more or less than $\tfrac{1}{2} l \sin \beta$ will be added to $h$ according as the span $BC$ is more or less than the normal length. A general statement of equation (19) would be as follows:

$$H' = h + kl \sin \beta - k'd \qquad (20)$$

where,

$$k' = \left[\frac{\text{length of assumed span } (AC)}{\text{length of normal span } (AB)}\right]^2$$

$$k = \frac{\text{length of normal span } (AB)}{\text{length of assumed span } (AC)}$$

The above method of obtaining the values of $k'$ and $k$ is limited to cases where the length of the assumed span $(AC)$ does not vary widely from twice the length of the normal span $(BC)$. This does not limit the practical application of the formula very much.

As an example of the above, suppose that 30-ft. poles are being placed along level ground and up a 10 per cent grade. The "angle of the grade" is the angle made by a line, drawn between the bottoms of two adjacent poles at the point where they enter the ground, with the horizontal, irrespective of the configuration of the ground between the poles. Let the poles be 100 ft. apart and the normal sag 1 ft. According to equation (20),

$$H' = h + \tfrac{1}{2} l \sin \beta - 4d$$
$$H' = 30 + 50 \sin 10^\circ - 4$$
$$H' = 30 + 8.65 - 4$$
$$H' = 34.65 \text{ ft.}$$

What would be actually done in practice would be to divide the extra 4.65 ft. by two and add one-half of it, or 2.30 ft., to the last pole on the level ground, thus making it 32.30 ft. high and cutting 2.3 ft. off of the first pole on the grade, thus making it 27.7 ft. high. If the change in slope should be so abrupt as to necessitate the use of an unusually long or short pole, the length should be made more nearly normal by making the length of the assumed span $(AC)$ less than twice the normal span $(AB)$. It is evident that, knowing the deflection in the wires, the length of span and the normal height of pole, a table of values can very easily be computed showing the value of $H'$ for the various changes in grade liable to be encountered in the erection of the line.

APPLICATION OF THE FORMULAS.

Find the sag in the wires at the lowest temperature, say, — 10° F., the sag in the summer time, say, a temperature of 70° F., and the diameter of poles for a transmission system which is to consist of six No. 1 wires on cedar poles whose cross-arms are 32 ft. above the ground, allowing for a ⅛-in. coating of ice and a wind pressure of 30 lbs. per sq. ft. There are to be 60 poles per mile. If a 120 deg. turn is made in the line, what is the moment of the force to be counteracted by guying? If there is a 7 deg. variation in slope, how high should be the pole next to the slope, and the first one on the slope, in order to keep the tension in the wires in equilibrium?

$$\frac{T_m}{n} = 1125 \text{ (factor of safety of three used).}$$

$$l = \frac{5280}{60} = 88 \text{ ft.}$$

The weight of insulated No. 1 wire per foot is .322, the diameter = approximately 3 in. The weight of a ⅛-in. coating of ice per foot would be .072 lb.

$$w = .322 + .072 = .394.$$
$$P = (.05)\ (30)\ (.55) = .825 \text{ lbs.}$$
$$W = \sqrt{(.394)^2 + (.825)^2} = .913 \text{ lbs.}$$

The minimum deflection $d$ or the sag at — 10° Fahr. would be

$$d = \frac{(88)^2 (.913)}{(8)\ (1125)} = .78 \text{ feet, say 9 inches.}$$

The length of wire in a span with this sag would be

$$L' = 88 + \frac{(8)\ (.75)^2}{(3)\ (88)} = 88.017 \text{ feet.}$$

The length of wire in the span at 80° Fahr. is

$$L'' = 88.017\ (1 + (.000004)\ (80)) = 88.047$$

The deflection at a temperature of 70° Fahr. would then be

$$d_t = \sqrt{\frac{(3)\ (88)\ (88.047 - 88)}{8}}$$

$$d_t = 1.2 \text{ feet, say 14 inches.}$$

The diameter of pole is estimated as follows:

$$T = \frac{l^2 w}{8d} = \frac{(88)^2\ (.394)}{(8)\ (.75)} = 490 \text{ lbs.}$$

$$NT = (6)\ (490) = 2940 \text{ lbs.}$$

$$P_t = .05 p D_w l N + \frac{.05\ p D'' h}{2}$$

At this point it is necessary to assume a value of $D''$, which is to be corrected for by resolving in case $D'$ varies very much from the value chosen. Let $D''$ be taken as 12.5, which would correspond to a pole with a 15-inch base and a 10-inch top.

$$Pt = (.05)\ (30)\ (.55)\ (88)\ (6) + \frac{(.05)\ (30)\ (12.5)\ (32)}{2}$$

$$Pt = 735 \text{ lbs.}$$

$$W = \sqrt{(2940)^2 + (735)^2} = 3175 \text{ lbs.}$$

The diameter of the pole at the point where it enters the ground would be

$$D = \sqrt[3]{\frac{(32)\ (3175)\ (32)\ (12)\ (3)}{\pi 11000}}$$

$$D = 13.7, \text{ say } 14, \text{ inches.}$$

The moment of the force to be counteracted by guying if a turn of 120° were made would be

$$(2)\ (3175)\ (\cos 60^\circ) = 3175 \text{ lbs.}$$

For a change in slope of 7 degrees:

$$H' = 32 + (\tfrac{1}{2})\ (88)\ (\sin 7^\circ) - (4)\ (.75)$$
$$H' = 32 + (5.35 - 3.00) = 32 + 2.35$$

Hence, the last pole before reaching the change in slope should be made 33.17 feet high, and the first on the grade 30.83 feet high, in order to keep the tension in the wires in equilibrium.

## Why Wooden Poles Break Above Ground.

BY CLINTON B. SMITH.

It is a matter of observation that most tall wooden poles of, say, 40 ft. and over in length, when blown over by storm, will break a considerable distance above ground.

This fact would lead one to think that the weakest section is not at the ground level, but at some higher point on the pole. The following investigation shows that a pole of uniform taper and free from knots and other local weaknesses is weakest at a definite distance from the top, this distance being independent of the pole length.

This distance is $x = d \div 2t$ in which all distances are in inches, and in which $d$ = diameter of pole top; $t$ = taper of pole, or increase in diameter in inches per inch of length; $F$ = horizontal stress due to wires on cross-arm.

The pole is weakest where the fiber stress is greatest. Therefore, in order to find the weakest point, it is necessary merely to locate maximum fiber stress for any value of $F$.

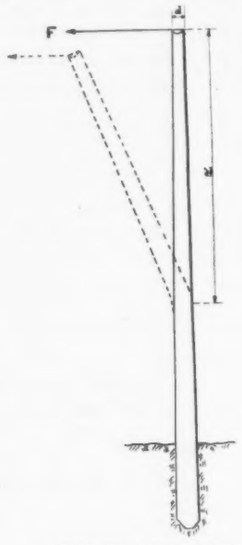
At any section along the pole at a distance $x$ from the top,

$$Fx = \frac{If}{e}$$
$$= .098\, d_x^3 f \text{ (for round section)}$$

where $I =$ mom. of inertia of section.
$f =$ stress in outer fiber.
$d_x =$ diam. of pole at distance $x$ from top.
but $d_x = d + tx$.
Therefore

$$f = \frac{F}{.098} \frac{x}{(d+tx)^3}$$

It will be observed upon differentiating that $f$ reaches its maximum value when $x = d \div 2t$. This is the critical value of $x$



BREAKING OF POLES ABOVE GROUND.

corresponding to the maximum value of $f$, the fiber stress; the pole, if free from local weaknesses, will break at this distance from the top.

Taking the case of an Idaho cedar pole having a top diameter of 8 in. and an average taper of .01 in. per inch.

$$d = 8$$
$$t = .01;$$

whence,

$$x = d \div 2t = 400 \text{ in.}$$

Hence the pole will break 33 ft. 4 in. from top, no matter how long the pole may be, provided the pole has at least this length above ground. A pole shorter than this length above ground will break at the ground.

## Turbine Economies.

By J. R. Bibbins.

In your issue of Jan. 11, Mr. W. L. R. Emmet has presented a very striking comparison of Curtis and Parsons turbine efficiency. It is rather surprising, however, that he has allowed himself to fall into technical errors which are clearly manifest upon even the most cursory analysis. Presumably these errors are chargeable to a too hasty examination of the subject; but as the casual reader is certain to be misled, I feel it my duty to present the problem in a more accurate form. And I rather think that Mr. Emmet himself, upon reviewing the facts of the case, will not be able to extract much comfort from his own argument.

With most evident inconsistency he has drawn certain relative comparisons between turbine performances under different conditions, ostensibly upon the basis of "published data," but actually upon entirely unpublished data of the Curtis turbine. And finally he begs the question altogether by arguments for higher vacuum unsupported in actual practice.

Now, this discussion has nothing whatever to do with the ultimate value of extreme vacuum. That is a question by itself and will be determined upon its merits. If higher vacuum is a good investment, we may expect to see future power plants designed on that basis. The question of an extra inch of vacuum, however, will never be the deciding factor as to *type* of turbine; for, so far as the turbine itself is concerned, the advantage of high vacuum over low vacuum will, regardless of type, be unquestioned. The important point is, however, that these extreme vacua are not at present usually obtained. I do not believe we should find one per cent of the condensing stations of this country carrying 29 in. of vacuum *the year around*. Most engineers would to-day regard 28 in. as rather high, and less than that is more common. The turbine user is concerned only in the commercial aspect of this question. He is, therefore, interested only in *results*—not those which he might get under conditions which he does not or cannot afford, but those obtained under the conditions which really exist.

The general question, then, is one of relative inherent economy of two prominent types of steam turbines, as evidenced by recorded performance, while the immediate discussion bears upon a comparison of two recent tests of these two types under different conditions of operation; and I had previously attempted to show that the Curtis turbine results, under conditions obtaining in the Chicago Edison tests, were inferior to the Parsons when equated with those prevailing during the New York Edison tests.

At the outset, I cannot permit, without the fundamental data, the introduction of another series of economy curves, *CC* (Jan. 11, page 102). purporting to represent Curtis turbine performance under two different operating conditions—the one corresponding to the moderate conditions of the New York Edison Parsons test, and the other to the high conditions of some unpublished tests on the Chicago Edison turbine. Under both conditions, the Parsons turbine is depicted as hopelessly inferior to the Curtis, and moreover, the accuracy of both the Parsons tests brought into the comparison (one made by Mr. H. G. Stott at the Interboro plant, and the other by Mr. J. P. Sparrow at No. 2 Waterside station) are directly brought into question by Mr. Emmet in his misunderstanding of results—a fact requiring no further comment. He has thus—perhaps unconsciously—diverted attention from the one point at issue, stated above, viz., the direct comparison of the *original* Chicago Edison with the New York Edison tests under the *reasonable* operating conditions of the *latter* plant.

Now it is evidently a hopeless task to discuss effectively a comparison of this kind if additional complications, extraneous in character, are to be continually introduced. If such complete tests had been made at Chicago by independent parties, under all conditions of load, pressure, vacuum and superheat, that results could be taken for comparison "without appreciable correction," as he claims, would it not facilitate matters (permission assumed) to place on public record the original results obtained directly under such conditions, particularly under moderate vacua and superheat, such as obtained during the New York Edison tests? Unauthenticated and irrational curves, such as have been presented, will manifestly not suffice for the purpose.

In order, therefore, to confine the issue to *existing published data*, as Mr. Emmet desires, I shall consider only the points noted in order below, and each as briefly as possible for the benefit of those who have not the time nor patience to follow the more detailed analysis appended. I desire to point out here, however, that *upon this analysis alone* rests the merits of this comparison, and the specific errors involved should be pointed out in any rejoinder.

(1) *Parsons Tests Improperly Presented.*—The original curves *BB*, replotted as lines II and III, sheet B, purporting to represent Parsons economies for both high and moderate operating conditions, are so greatly mislocated as to lead directly to an absurdity. Compare them with the original test, line I, and also with the true water lines IV and V.[1] I feel safe in saying that no characteristic yet exhibited by the steam turbine would result in such a sudden departure of the water

[1] To facilitate the examination of the results presented, I have first used the total steam, or water-consumption line, instead of the water-rate curve, which is infinitely more valuable in turbine work for revealing irrational results.

line to a decided curve tangent at about 5000-kw load as Mr. Emmet's deductions indicate. This will be apparent from the fact that curve II crosses the original water line at 4500 kw. Can we bring ourselves to believe that any turbine would have the same steam consumption at 150 lb., 2.2 per cent moisture and 28 in. as at 177 lb., 96 deg. and 27.31 in. vacuum? The difference in water, due to this difference in conditions, should be roughly 16.7 per cent decrease for pressure and superheat and 3.7 per cent increase for vacuum, leaving a net decrease of 13 per cent, as shown by the true curves, IV and V. Again, following the same reasoning for curve III, which also tends to intersect the original tests at a load of 3500 kw, the absurdity is likewise apparent, for this intersection would indicate that an increase of 27 lb. and 100 deg. superheat is exactly offset by 1 in. in vacuum. Imagining an immediate line for 28.5 in. vacuum, it is hard to believe that at 4000-kw load, the probable intersection, an increase of 27 lb. and 100 deg. superheat results in no improvement in economy. From the irrational nature of these curves, only one inference seems possible

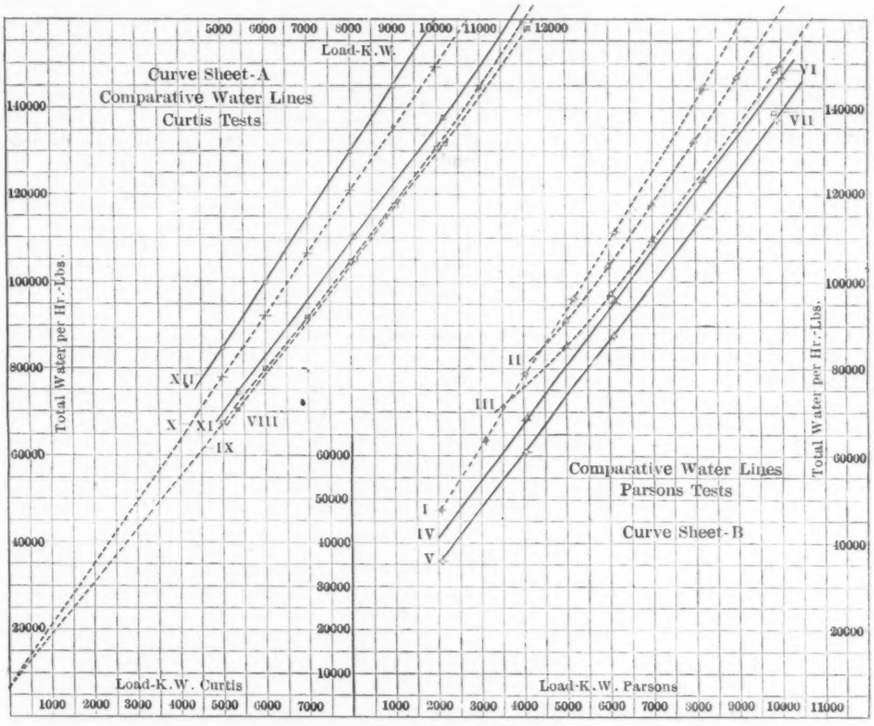



FIG. I.—CURVE SHEETS A AND B—COMPARATIVE WATER RATES.

Curve I.—Original tests, 5500-kw Parsons turbo-generator, Manhattan station, by Mr. H. G. Stott. Approximate conditions, 150 lb., 2.7 per cent moisture, and 28 in.
Curve II.—The same, as corrected by Mr. Emmet, to conditions of New York Edison Parsons test, 177 lb., 96 deg. and 27.3 in.
Curve III.—The same, as corrected by Mr. Emmet, to Chicago Edison conditions, 180 lb., 125 deg. and 29 in.
Curve IV.—The same, properly corrected to conditions of New York Edison Parsons test.
Curve V.—The same, properly corrected to Chicago Edison conditions.
Curve VI.—Actual test of 7500-kw Parsons turbine, New York Edison, Waterside station, uncorrected. Conditions, 177 lb., 96 deg. and 27.31 in.
Curve VII.—The same, properly corrected to Chicago Edison conditions.
Curve VIII.—Original tests, 8000-9000-kw Chicago Edison Curtis turbo-generator, Fisk Street station. Approximate conditions, 190 lb., 150 deg. and 29.5 in.
Curve IX.—Unpublished tests of Chicago turbine reported by Mr. Emmet, for conditions, 180 lb., 125 deg. and 29 in.
Curve X.—The same, for conditions of New York Edison test.
Curve XI.—Original Chicago Edison Curtis tests corrected to 180 lb., 125 deg. and 29 in.
Curve XII.—The same, properly corrected to Chicago Edison conditions, 180 lb., 125 deg. and 29 in.

Lines IV and V, however, representing true Parsons results, are quite rational. For these, correction factors sanctioned by test and usage, as outlined under "Technical Analysis," were used. (See Appendix.)

(2) *Non-agreement of Parsons Tests.*—Mr. Emmet's figures indicate some 8 per cent difference in the results of the New York Edison and the Interborough Parsons tests, but with the proper location of his curves *BB*, the wide discrepancy disappears; likewise his inference of gross error in one or both of the tests. Point VI shows this New York Edison test plotted from original data uncorrected and directly comparable with line IV deduced from the Interborough test. Point VII shows these same tests reduced to Chicago conditions and directly comparable with the corresponding Interborough line V. These Parsons tests then show a difference in economy so small as to be quite negligible. Certainly 2 or 3 per cent variation between two different machines operated in different plants and under widely differing conditions of load cannot be called excessive.

(3) *Curtis Results Irrational.*—Coming now to the new data introduced from unpublished tests of the Chicago turbine, I find that both the original curves *CC, replotted* as lines IX and X for moderate and for extreme operating conditions, are entirely inconsistent; neither do they agree in any respect with the original Chicago tests now on record. I will content myself, therefore, in simply pointing out the inconsistency of these special tests, basing final calculations on the original tests and using correction factors advocated by Curtis turbine engineers, as already on record before various scientific societies. (See methods of correction, Appendix.)

First, note the extremely small difference between curves VIII and IX, both stated to be uncorrected tests. Analyzing this difference, we are confronted by the conclusion that the Chicago machine at full load showed a negative rate of improvement between 29 and 29.5 in. vacuum, of less than 0.1 lb. per kw-hour per inch of vacuum (see Appendix), roughly, 1/10 of that claimed for these Curtis turbines, and this a negative, not a positive, improvement.

Second, note the wide divergence of curves IX and X, which tend to *intersect* at about no-load. Can we avoid *this* inference that at no-load the Chicago machine required the *same* amount of steam at 96 deg. and 27.31 in. as for 125 deg. and 29 in.; or even neglecting the 29 deg. increase in superheat, is the increased vacuum of no value? This extra 1.7 in. vacuum should result in a practically *constant* decrement of water per hour at all loads, amounting to nearly 12 per cent of the full-load consumption. Compare the Parsons water lines, IV and V, for the same conditions. Their rational character is shown by the fact that they are nearly parallel through the entire range of load—the slight divergence being due to the increased superheat.

In spite of unanimous statements to the contrary by Mr. Emmet and his associates, the data he presents thus indicate that *the value of extra vacuum progressively decreases to zero at no-load.* This is so absurd upon the face of it that in addition to other disagreements pointed out above, it has influenced me in not considering further the tests represented by the original curves *CC* (Jan. 11, page 102). These inconsistencies must involve error in one or three sources: (a) The original Chicago tests; (b) the basis of correction; (c) the subsequent tests. No data are at hand for analyzing the last. No glaring irrationality attaches itself to the first test. We are, therefore, face to face with the proper method of correction.

The Curtis results, properly corrected, are, however, consistent, as shown by lines XI and XII. Here again the slight

divergence is due to the increase in superheat, as in the case of Parsons lines IV and V.

(4) *True Relative Economy.*—Coming finally to the principal point at issue, curve sheets C and D indicate the true relative[1] economy of these two machines to be as follows: Parsons, 15.08 lb. per kw-hour; Curtis, 16.05 lb. per kw-hour—a difference of 6½ per cent—both under New York Edison conditions—177 lb., 96 deg. and 27.3 in., 9865 kw-load.

I now recall my former statement and find that it is borne out in fact, as well as in principle, viz., that under test, the New York Edison Parsons machine shows the superior relative economy; this, and no more, was stated in the original report of the New York Edison tests. (*Proc.*, Am. St. & Int. Ry. Eng. Assoc., October, 1907.) And further, the Interborough tests indicate a superior economy, not only at this, but at all loads. On the other hand, from the relative location of the 29-in. vacuum curve, it appears that the Curtis turbine is slightly better than the Interborough tests indicate this particular machine would be at the same vacuum. The Interborough turbine, however, was built for 27.5 in. vacuum. Had it been designed for 29 in., the improvement with the higher vacuum would undoubtedly have been greater. And, from its good performance under its designed vacuum, I should anticipate better economies at 29.5 in. than these Chicago Curtis tests show. This, however, is a question irrelevant to the discussion.

For the actual performance of a Parsons machine designed for and tested under favorable conditions, I may refer to the Parsons tests at Carville station, Newcastle, at 5164-kw load, 200 lb. pressure, 120 deg. superheat and 29 in. vacuum—13.19 lb. per kw-hour, intrinsically a better result than obtained at Chicago, as the water rate was but 0.29 lb. higher with 0.5 in. lower vacuum.

(5) *Thermal Efficiency from Actual Tests.*—If it still be held that all corrections for operating conditions are misleading and inadmissible, there remains one basic relation upon which heat-engine efficiencies can be correlated, viz., kinetic efficiency or thermal efficiency ration; i. e., the ratio of the actual water-rate to the ideal water-rate of the Rankine-Clausius cycle, for the conditions involved. It is, therefore, pertinent to the subject in hand to present these officiencies based upon *uncorrected* test data. This basis of comparison is quite definite, with one exception—the specific heat of superheated steam—and in the following comparison a variable value around 0.56 has been used in accordance with the more recent expositions of the subject by Professors Thomas, Knoblauch and Jacob.

1. The Curtis machine at 10,186 kw, 176 lb., 147 deg. and 29.47 in. gave a water rate of 12.9 lb. per kw-hour. This is equivalent to a kinetic efficiency, or ratio of ideal to actual, of 62.1 per cent.

2. The New York Edison Parsons turbine at 9865 kw (six-hour constant-load test), 177 lb., 96 deg. and 27.31 in., gave a water-rate of 14.98 lb. per kw-hour. This is equivalent to a kinetic efficiency of 67.3 per cent—5 per cent higher efficiency than the Curtis with its desired high vacuum. Again, therefore, I repeat my statement as to the efficiency record now being held by the New York Edison machine in American turbine practice, as based upon *actual* tests.

Reviewing the letter in general, our critic would accord the poor, old-fashioned Parsons turbine a humble place, indeed, in relative ability to transform steam into kilowatts, yet he actually expresses the belief that he has done it "more than justice" in his deductions. But we cannot allow him to find refuge in the ethereal joys of 29.5 in. vacuum either as a standard operating condition or a basis for commercial testing. In fact, he himself admits as much in the statement that at Chicago the vacuum only "sometimes" reaches 29.5 in. This, to be sure, is fair condenser performance with 32 deg. water, but hardly to be considered as a normal operating condition in present turbine practice. Notwithstanding, we are treated to a delectable series of tests under these particular conditions as a characteristic measure of Curtis turbine efficiency. Does it seem reasonable that if other builders seek to meet the *prevailing* commercial demand for a more reasonable vacuum, they should be compelled to relinquish the very considerable advantage which the high-vacuum advocate claims as his special perquisite? Such is the argument in this, as well as previous comparisons by the same author, particularly with reciprocating engines (*Proceedings*, N. E. L. A., 1907). Such eagerness for the last fraction, as is here displayed, almost suggests the *inherent necessity therefor*, of which other builders are inferred to be in blissful ignorance. "Where high vacuum can be secured it is folly to use low vacuum." But bear in mind that a higher rate of improvement from better operating conditions carries with it the converse proposition that the internal losses are greater when the vacuum and superheat drops. It seems to me that if your correspondent cannot "hitch his wagon to a star" in fact, as well as fancy, he is treading on dangerous ground.

It is claimed by the high-vacuum advocates that any amount of investment in a high-vacuum plant will be well repaid from

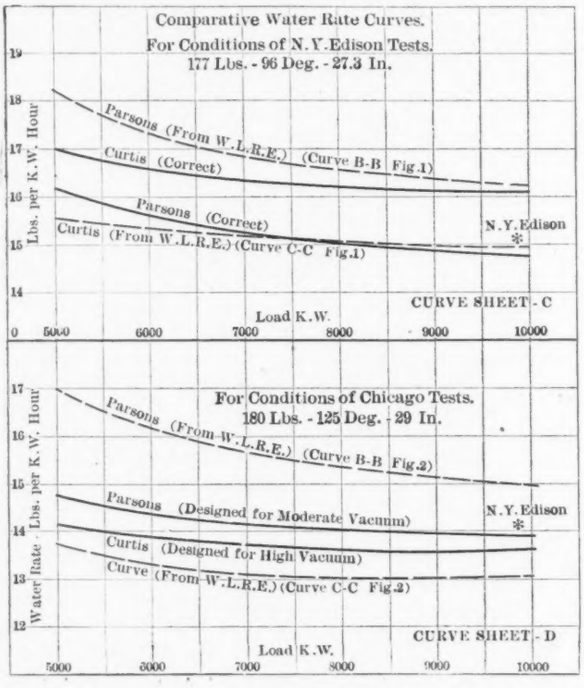

Comparative Water Rate Curves.
For Conditions of N.Y.Edison Tests.
177 Lbs. - 96 Deg. - 27.3 In.
Lbs. per K.W. Hour
Parsons (From W.L.R.E.) (Curve B-B Fig.1)
Curtis (Correct)
Parsons (Correct)
Curtis (From W.L.R.E.) (Curve C-C Fig.1)
N.Y.Edison
CURVE SHEET - C
Load K.W.
For Conditions of Chicago Tests.
180 Lbs. - 125 Deg. - 29 In.
Water Rate - Lbs. per K.W. Hour
Parsons (From W.L.R.E.) (Curve B-B Fig.2)
Parsons (Designed for Moderate Vacuum)
Curtis (Designed for High Vacuum)
Curve (From W.L.R.E.) (Curve C-C Fig.2)
CURVE SHEET - D

FIG. 2.—CURVE SHEETS C AND D—COMPARATIVE WATER RATES.

an ultimate commercial standpoint. Is this true? Has anyone ever endeavored to determine the average effective vacuum for the year around, even on tide-water? For water temperatures around the freezing point, the high-vacuum is, of course, admitted, but how about warm weather? Note the following table:

POSSIBLE VACUUM—WATER TEMPERATURES.

| Temperature cooling water. | Theoretical possible vacuum. | Perfect condenser, no temp. dif. | Actual condenser, 15° dif. | Actual condenser, 15° dif. |
|---|---|---|---|---|
| Ratio water to steam. | Infinite. | 60 to 1. | 60 to 1. | 100 to 1. |
| 32 | 29.83 | 29.67 | 29.43 | 29.54 |
| 60 | 29.5 | 29.12 | 28.56 | 28.82 |
| 70 | 29.3 | 28.77 | 27.72 | 28.38 |
| 75 | 29.1 | 28.51 | 27.37 | 28.11 |

With 70 deg. water, a perfect condenser can give a maximum vacuum of only 29.3 in. And as modern surface condenser equipments seldom discharge less than 15 deg. below steam temperature, the maximum vacuum possible at this temperature and a reasonable water ratio of 60 to 1 is 27.7 in. With 60 deg. water, we may maintain 28.6 in., and with 75 deg. water only 27.4 in.

Now, 29-in. vacuum is by no means unusual in winter on lake or tide water, and is certainly not confined to the Chicago Edi-

[1]This comparison is based entirely upon results obtained during the middle six hours out of the continuous eight-hour test at the New York Edison plant, permissible owing to fall in load and high-condenser leakage, and the fact that this machine had been under full load for only 10 minutes prior to the beginning of the eight-hour test.

son station; but it is hardly logical from any standpoint to construe the geographic as a strictly technical advantage in comparisons of tests. The question that usually confronts the manufacturer is not the design of a machine to meet conditions only occasionally arising, but rather to meet the average operating condition that will obtain in the actual plant.

To conclude, I cannot help but feel that this entire subject of the effect of operating conditions on turbine economy, and the commercial considerations arising therefrom, is at present in an exceedingly muddled state. There is nothing mysterious about the subject which the turbine builder must guard as an invaluable secret. In fact, it is quite as definite as, for instance, the correction for temperature rise in generators, at different initial air temperatures, or the corrections for different initial temperatures of measurement.

It seems to me it lies within Mr. Emmet's power to establish very effectively his position in this entire matter. He and others who have published results on the Curtis turbine have quite uniformly adhered to conditions of high vacuum and superheat only, and have, therefore, made it necessary to introduce cor-

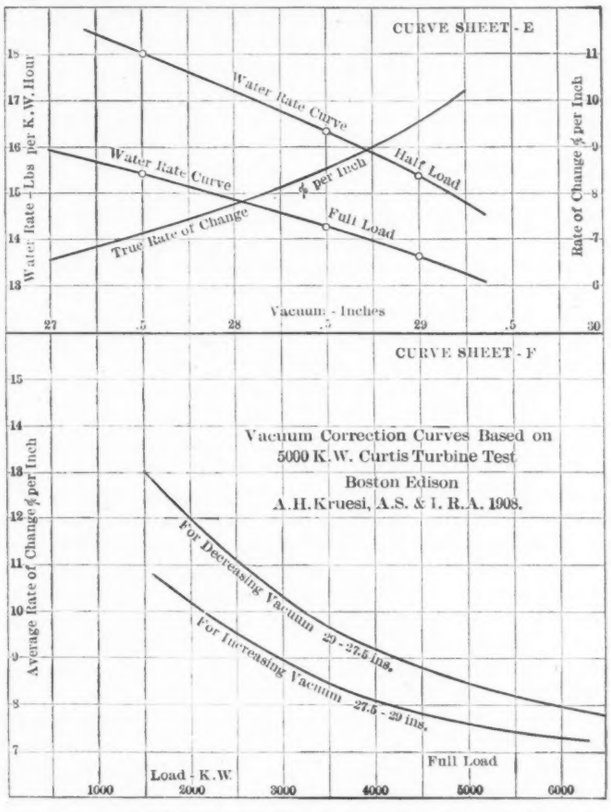



FIG. 3.—CURVE SHEETS E AND F—VACUUM CORRECTION CURVES.

rections for purposes of comparison with other units. In view of the present discussion, he might give us the original results obtained from a Curtis turbine of about the same size, working under approximately the same conditions—in fact, standing alongside of the New York Edison Parsons turbine, whose economy I have discussed above.

APPENDIX.—TECHNICAL ANALYSIS.

The technical analysis involves two important points—analysis of total water lines and correction factors used. Let us discard for the moment water curves and examine the results by means of the total water or steam consumption line—a valuable turbine characteristic. Experience has shown this to conform faithfully to a straight line, as in the Willans law, regardless of the method of governing[1] employed; i. e., within almost the entire range of load controlled by primary admission of steam. This is true of the Curtis, as well as the Parsons type, and it has been illustrated so often in turbine literature that no further proof is necessary. On the other hand, the water line of a cut-off engine shows a radical curvature approximating the Willans law only in the neighborhood of best economy. We also know that the effect of a change in vacuum is to displace the total water line practically *parallel* to itself, while with superheat, the displacement is *divergent* about an origin usually representing zero steam consumption. This is quite reasonable, for we know that while an increase in both vacuum and superheat adds a definite and constant percentage of energy to each pound of steam, their effectiveness in reducing internal fluid friction are quite different in kind. Vacuum operates progressively from exhaust to admission; superheat the reverse. With higher vacua, the mean effective density (if I may use the term) is little affected at heavy loads; with superheat, at light loads. Upon these premises, it follows that the *rate* of change in economy due to superheat will be approximately constant at all loads; for vacuum, variable, decreasing with increasing load. Such a vacuum relation may be found in tests of 5000-kw Boston Edison turbine (Kruesi, *Proc.*, Am. St. & Int. Ry. Eng. Assoc., 1907, Fig. I). Curve sheet *E* represents the fall in *water-rate* with increasing vacuum at full-load and half-load, respectively. Both curve downward more rapidly on the higher vacua, indicating a greater proportion of gain in this vicinity. This is borne out by the curve showing "True Rate of Change." Around 27 in., the change in economy per inch is 6.6 per cent; 28 in., 7.8 per cent, and 29 in. 9.5 per cent, corresponding to 1.3 lb. per kw-hour per inch. At half-load the change is even more pronounced on high vacuum.

Now the *rate of change* (slope of curve) is quite a different matter from improvement in water-rate between two definite limits, i. e., the average. And, furthermore, much depends upon which way the change is made. Thus, for a total range from 29.0 in. to 27.5 in., the average *increase* in rate is (at full-load) 1.17 lb. per kw-hour per inch, or 8.5 per cent per inch; while from 27.5 in. to 29 in. the average *decrease* in rate is but 7.6 per cent. Carrying this analysis one step farther, Sheet F shows this rate of change for various loads under these two conditions—increasing and decreasing vacuum. For example, 1 in. *decrease* below 29 in. results in an increase in water-rate of 11.1 per cent per inch at half-load, as compared with 8.5 per cent at full-load.

These last curves may now be used as a basis for calculations for the Curtis turbine under discussion. That they seem reasonable is evident from Mr. Emmet's statement (*Proc.* N. E. L. A., 1907), "the available energy with 29 in. is 10 per cent higher than that with 28 in. vacuum, * * * and between 28 in. and 28.5 in. the gain is very nearly proportionate to theory." Likewise, Mr. Kruesi (*Proc.* Am. St. & Int. Ry. Eng. Assoc., 1907) says, "raising the vacuum from 28 in. to 28.5 in. makes 5 per cent more energy available, and of this the turbine realizes an improvement of from 0.5 lb. to 0.6 lb. per kw-hour at rated load," equivalent to a rate of 1 lb. to 1.2 lb. per kw-hour per inch of vacuum (we have already used 1.17 lb.). Therefore, as the rate is still higher from 29 in. to 29.5 in., I am at least conservative in taking curve sheet *E* as a basis for correcting the Chicago Edison tests.

For the Parsons turbine, the rate is known to be much smaller, and as the Interborough tests are on record, I need not elaborate here. Suffice it to say that I have used a similar factor variable with load and vacuum. As the difference in water due to 1 in. vacuum—about 4500 lb. per hour—holds constant practically within the limits of primary admissions of steam, other loads, including the New York Edison tests, may be found by exterpolation. Thus, at 7500 kilowatts, the average rate of change per inch around 28 in. is 3.42 per cent; at 5000-kw load, 5.1 per cent. In the detailed calculations, due allowance has, of course, been made for increasing and decreasing vacuum, as above outlined in case of Curtis curves.

Both types of turbines seem to benefit about equally from superheat around 100 deg., so that we may assume an equal rate

[1]Incidentally, the Willans law is supposed to apply only to the principle of pure throttle governing. Hence, it is quite reasonable that the Parsons type should show this characteristic; also the Rateau. That the Curtis likewise conforms, indicates how closely the multiple nozzle system of governing approximates that of pure throttling.

of change—1 per cent per 12.5 deg. (For the total change of 100 deg., however, the Parsons usually benefits 10 per cent.) Likewise, an equal gain for pressure and quality for the former, 1 per cent per 10 lb. change around 175 lb. is assumed—a little less for wide ranges; for the latter, a correction double the percentage of moisture content—this to take account of the well-known effect of moisture in increasing internal friction, a factor with which the reciprocating engine does not have to contend.

To illustrate the method of applying these various factors, take, for example, the derivation of line *IV* from the original test line *I*:

Test: 8174-kw, 149 lb., 27.78 in., 2.7 per cent moisture. Correct to 8174-kw, 177 lb., 27.31 in., 96 deg. superheat.

Pressure: 26 lb. low; correction for this range, say, 2 per cent to be conservative, factor $= \frac{1}{1.02}$.

Moisture: 2.7 per cent; correction to dry steam for this range, say, 5 per cent, factor $= \frac{1}{1.05}$.

Superheat: 96 deg. low, correction for the range, 9.72 per cent, factor $= \frac{1-.0972}{1.00} = 0.903$.

Vacuum: 0.48 in. high, correction for the range, 1.488 per cent, or 3.1 per cent per inch, factor = 1.01488.

Original steam consumption: 144,210 lb. per hour, then,

$$144210 \times \overset{(Sup)}{.903} \times \overset{(Pres)}{\frac{1}{1.02}} \times \overset{(Moist)}{\frac{1}{1.05}} \times \overset{(Vac)}{1.01488} = 123200 \text{ lb. per hour.}$$

Corrected water rate: $\frac{123200}{8174} = 15.07$ lb. per kw-hour.

Note here that some of the factors are inverted, depending, of course, on which way a correction is made from a given standard. Thus, using 150 lb. as a basis (100 per cent), the pressure factor would be 0.98; with 175 lb. (100 per cent), it is the reciprocal of 1.02, meaning that at 175 lb. the water consumption is $\frac{1}{1.02}$ or 0.98 + of that of 149 lb. For small changes, the difference is inappreciable, but for large, especially in vacuum, it is material, as already pointed out in curve sheet *D*. This method has been followed in all of the curves involved, for which the factors are given in the appended table

Finally, one example of the converse synthetic method, as applied to Mr. Emmet's water-lines IX and X leads to the following illogical results already noted above:

Test: 8070 kw, 197 lb., 29.55 in., 116 deg., 13. lb. per kw-hour. Corrected to 180 lb., 29.0 in., 125 deg. Difference, 17 lb. low, 0.055 in. high, 9 deg. low.

$$13.0 \times \frac{\overset{(Pres)}{1.0}}{1-0.17} \times \frac{\overset{(Supht)}{-1-.10}}{1-0.928} = 13.12 \text{ lb. per kw-hour for 29.55 in.}$$

Water-rate from line IX, 13.07 lb. per kw-hour for 29.0 in.

*Negative* improvement due to 0.55 in. vacuum = 0.05 lb. per kw-hour.

Note here that the only conclusion permissible from line IX is that ½ in. *extra* vacuum above 29 in. actually *increases* the water-rate instead of decreasing it, as it should. This shows conclusively that in line IX, as derived from original curve *CC*, sufficient allowance has not been made for operating conditions. This same method of analysis applied to other points in line IX shows a *positive* improvement with vacuum, as it should, but at an entirely too low rate—less than 0.1 lb. per kw-hour, whereas the rate of improvement claimed is from 1 lb to 1¼ lb. per kw-hour.

## Spectrophotometer.

Mr. R. A. Houstoun in the *Philosophical Magazine* for February describes an attachment which may be fitted to any spectrometer or spectroscope converting it into a spectrophotometer, and which may be removed at once when the ordinary use of the instrument is desired. A method for applying the instrument to the measurement of absorption in the ultraviolet is also described.

## Central-Station Heating Load.

Mr. Errett L. Callahan briefly presented the advantages of electric heating load, and suggested some methods of securing it, in a paper before the Northwestern Electrical Association convention at Milwaukee, Jan. 15. He knew of no easier way companies could secure the desired result of getting more revenue with existing investment than by pushing the use of heating devices. Many of these are simple enough to be used in nearly every room in the house by any one, and may be connected to the usual receptacles provided. The central station can supply 75 per cent of the load demand at the present time without giving a thought to providing increased transformer, meter or plant capacity. If a central station does not operate a day circuit, he suggests that they follow the example set by several managers last spring, and for a trial start a day circuit to operate all day on Tuesdays, ironing day. A small motor load would then spring up and the plant would soon be forced to operate every day in the week. As to soliciting business, he suggested that personal solicitation, although the most expensive advertising, is by far the most productive. He thought if the expenses for maintaining a new-business department were divided as follows, the highest efficiency would be obtained: One-half for salary of solicitors and demonstrators; one-fourth for maintenance of exhibit and demonstration room; one-fourth for direct by-mail and newspaper advertising. The trouble with some solicitors is that they do not follow up their first efforts to get business, and hence lose what little advantage they may have gained. He was sure that it was a mistake for public service corporations to neglect to at least provide an attractive display of current-consuming devices, even though it might not be elaborate. Ill-kept and dirty show windows, with the exhibit material always in the same location and consisting of the same devices that passers-by have seen for weeks and months, detracts rather than attracts. He then gave the results of cooking by electricity in his own home, in which for a period of a year the watt-hours per person per meal averaged 264.

In the discussion Mr. J. R. Cravath was called on to give his experience with electric cooking in the home. He said that an experience of several months had convinced him that Mr. Callahan's figures of 300 watt-hours per person per meal is a safe one to assume. He had recently made an experiment for the benefit of central station companies to determine the probable consumption of electrical energy per month, using only the flatiron and the chafing dish on the dining-room table, all other cooking being done by gas. He did this because he believed the chafing dish and flatiron to be the two devices which central stations could successfully push with hope of increasing revenue. A trial of a month and a half showed that the consumption of the chafing dish and flatiron ran about 20 kw-hours per month. A chafing dish was used a great deal in his family, especially for breakfast. He believed that next after the flatiron, the merit of which was already well established, the chafing dish was the thing which central stations could best afford to spend money in pushing, because when customers properly understood its use, they can apply it to so many dishes. He thought that central-station managers sometimes thought lightly of the possibilities of electric cooking because of the fact that at prevalent electric rates we cannot anywhere near compete with gas in point of economy. However, if we go a little further back, we must consider the fact that at prevalent gas rates we cannot anywhere compete with cheap soft coal. The fact of the matter is that there is room for all the easy methods of cooking, and we should not condemn any method simply because it cannot compete in point of economy alone. In a town where there is no gas, there is no competition from anything which is nearly as cheap and convenient as electricity. The only real competitors in such towns are hard coal or gasoline. Gasoline is dangerous and hard coal is a nuisance. An average family can do all the cooking electrically on a 5-cent per kw-hour rate cheaper than it can run a hard coal range.

Mr. Korst, of Janesville, Wis., said that his company had flatirons with about half of its residence customers. It got a very good revenue from that source, especially during the summer months. He finds, however, that when the bills creep up in the winter time people are apt to use their old irons heated on the coal ranges which are in use in the winter months anyway. In the summer, many customers' bills would fall below the $1 minimum. The flatiron will bring this a little above $1, which will give the company more revenue and the customer will feel better satisfied because he will feel that he is not required to pay for something he did not get. The flatiron also acts as a good solicitor to secure the wiring of new houses. Ladies become much attached to these flatirons and do a great deal of talking about them among their neighbors. This makes neighbors easier to approach on the subject of wiring their houses.

Mr. E. F. Strong, of Chaska, Minn., reported starting a day service last May. He had not received a single flatiron back from customers where placed on trial. Mr. R. N. Kimball, of Kenosha, had first attempted to introduce irons by having a demonstrator in the office, but did not get much business that way. The demonstrator was then sent out to solicit the different houses, and the results were very much better. Fully 75 per cent of the irons sent out on trial were kept and not returned to the office.

In answer to an inquiry by Mr. Kemper, Mr. Callahan said that his maximum demand for home cooking is about 2.8 kilowatts. Mr. Cravath said that his maximum demand was about 3 kilowatts. His figures included ironing, and Mr. Callahan's did not. Mr. Kemper said that if the maximum demand was 2.8 kilowatts and the total consumption for the year 803 kw-hours, as Mr. Callahan stated, that would give a use of less than 300 hours a year for the maximum demand, or less than one hour a day. He thought 5 cents a rather low rate to give to business used less than an hour a day. His company was putting out flatirons and they very seldom were on at the peak, but the cooking comes more or less on the peak.

Mr. Cravath explained that the amount that comes on the peak depends entirely on whether it is a large city where the principal meal is at night or whether it is in a small town where the principal meal is in the middle of the day. With the majority of central-stations the cooking peak would be in the middle of the day. The real question in which central-station men are interested is whether much extra money must be invested to carry this heating load over and above that which would have to be put in to carry the lighting load. In an analysis of this question which he had made, it was found that the maximum station demand per customer would be, with a large number of customers, not over 1.2 kilowatts for the cooking load. The fixed charges per customer should, therefore, be based on the 1.2-kw demand instead of 3-kw. Mr. John S. Allen said he had been successful in selling a lot of appliances in his town, but that he could not give any general rules for procedure except that in towns of 5000 inhabitants or less personal solicitation is the only successful way of getting these customers.

Mr. Callahan in closing the discussion said that his company (General Electric) had started out a corps of demonstrators with heating apparatus for central stations about two years ago. Conditions, however, were changing and some of these demonstrators had been trained as solicitors, a number having become very expert. He believed this the proper plan for putting out flatirons as well as other devices, although, of course, percolators and chafing dishes could not be left at houses on trial unless three or four were set aside for that purpose and new ones sent when the purchase was made. This year he was trying to secure young men from college during the summer months. Last year the basis upon which these solicitors were sent out to central stations was that the central station paid 25 cents an iron, plus the solicitor's railroad fare and board. Manufacturers guaranteed the salary. He agreed with Mr. Allen that in a small town the placing of irons was very different from in a large city. Personal solicitation pays best in small cities, while in large cities it does not work at all. The Commonwealth Edison Company, of Chicago, started out a lot of demonstrators and solicitors and spent a lot of money in this way. These would find no one at home or could not get into the house. The company then adopted the plan of sending out follow-up letters and sold 1500 irons in that way at small expense.

## New Telephone Patents.

PARTY-LINE SYSTEM.

A party-line system of what might be called the sectional line variety has been patented by N. E. Nostrom, of Chicago. With this system each station has associated with it one section of the line, viz., that section between it and the station next nearer the central office. The first station carries the central-office apparatus at the inner end of its section. Means are provided at all stations whereby any may signal the operator with the line in its normal disconnected condition. The operator responding is enabled to talk to the caller over a grounded circuit and thereby learns his location and the desired station. These stations are then selected.

A make-and-break device with the number of impulses controlled is set in operation to select the desired station. The operator first inserts contact plugs into apertures bearing the station designation, and the arm is then started over the dial. As the arm moves, it causes current impulses over the line. These affect building-up magnets at the stations. The first impulse connects the second section to the first, the second, the third to second, and so on. Now, wherever a contact plug is passed, a secondary grounded circuit is closed simultaneously with the building-up circuit, with the result that the connecting magnet at the corresponding station cuts in the station telephone apparatus. Thus, when the line is built up, the stations corresponding to the contact plugs are connected to the line, the number so connected depending entirely upon the number of contact plugs in the dial. When conversation is complete, the operator can clear out the line by ringing over it. An alternating-current relay at each station responds and restores the station relays to normal.

# LETTER TO THE EDITORS.

## Hunting of Alternators.

*To the Editors of Electrical World:*

SIRS:—Referring to your criticism in the issue of the ELECTRICAL WORLD of Feb. 15 of the writer's letter concerning your editorial on "Hunting of Alternators" in the issue of Jan. 25, it is quite evident that we are not discussing this subject from the same standpoint.

It seems to the writer that your remarks all refer to the period of oscillation of the engine as one unit and of the generator as another unit, whereas the writer refers to the unit oscillation of the generator and engine combined, which may be observed on the wattmeters of two direct-connected generators when operating in parallel. Successful operation depends directly upon its frequency and amplitude.

The writer believes that this unit oscillation was first observed by Mr. H. H. Barnes, Jr., about seven years ago (see "Notes on Fly-wheels," *Proceedings* American Institute of Electrical Engineers, Vol. 23, 1904), the writer being the first to record and measure the same, in the form of variation in angular velocity of the rim of a fly-wheel, and prove conclusively, he thinks, that a generator may increase the variation in angular velocity of a unit if not properly designed for connection to its prime mover. (See *Electrical World and Engineer*, Sept. 13, 1902, and April 18, 1903.)

The writer notes that you are unable to follow his outline of the difference between the period of oscillation of a synchronous motor and a synchronous generator, which is obvious from the

above; but it will be observed that if two direct-connected units, which possess certain characteristics that will allow them to operate successfully in multiple, are paralleled either with or without load, the unit oscillation may be observed on the wattmeters to be, say, 40 oscillations per minute, with the unit running at 90 r.p.m. If the steam is shut off from one engine and it is allowed to operate as a synchronous motor, the number of oscillations will immediately change to 90 per min., corresponding to the speed of the generating unit. This unit oscillation exists whenever two or more alternators are operated in parallel, whether driven with an engine, water wheel, turbine or any other prime mover.

Newark, N. J. P. C. Oscanyan.

[The fact that the interchange current between two synchronous machines has a frequency of 40 cycles per minute when they are operated in parallel as generators, while the fluctuations in the current taken by one machine when driven as a motor from the other as a generator has a frequency of 90 cycles per minute (the speed being 90 r.p.m.), furnishes no proof of Mr. Oscanyan's original statement that the natural period of oscillation of a synchronous motor always corresponds to the revolutions of the prime mover. When the fluctuations in the current to a motor are observed to correspond to the fluctuations in the torque on the shaft of the prime mover, one has evidence merely that the relative speed of the motor is somewhat more regular than that of the generator, and no indication whatsoever is obtained of the natural period of oscillation of the motor; the latter period depends solely upon its electric circuits and the total mass of its rotating parts, which is also true of the generator unit.—Eds.]

# DIGEST OF CURRENT ELECTRICAL LITERATURE

## Dynamos, Motors and Transformers.

*Standard Performances of Electric Machinery.*—R. Goldschmidt.—A paper illustrated by diagrams in which the author endeavors to provide in a convenient form data of what may be regarded as the standard performance of electric machinery. Continuous-current machines, rotary converters, alternators, induction motors and single-phase commutator motors are dealt with, and numerous curves of efficiencies and other properties

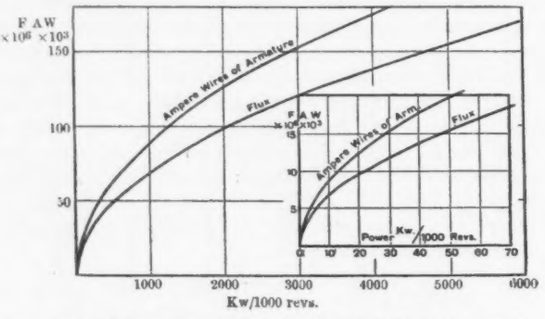



Fig. 1.—Standard Performance of Electric Machinery.

of such machines over a large range of sizes are given. In all electric motors and dynamos the kilowatts reduced to 1,000 revolutions per minute equal a "constant" multiplied by ampere-wires multiplied by flux. With direct-current machines, polyphase alternators and polyphase induction motors, the "constant" averages $0.165 \times 10^{-9}$. With single-phase machines it averages $0.145 \times 10^{-9}$. By "ampere-wires" is understood the total number of conductors which are cut by a plane in the middle of the armature at right angles to the shaft, multiplied

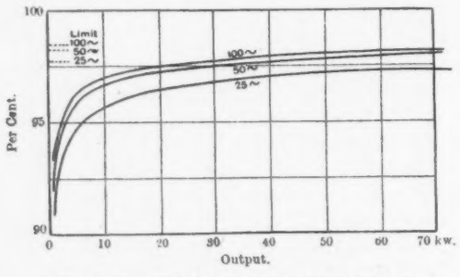



Fig. 2.—Transformer Efficiency Curves.

by the number of amperes per conductor. With induction motors the ampere-wires are those of the rotor only. The flux is the sum of all fluxes entering the armature from all poles together. It is naturally possible to obtain a certain value of power with an infinite number of combinations of ampere-wires and fluxes. In actual practice the value for the two will be of the same order if the current is expressed in kiloamperes as the unit, and the flux in megalines. Fig. 1 shows $F \times A W$ for different kilowatts at 1000 revolutions for machines having no commutating poles. In most cases these fluxes are identical with the most economical flux, especially for moderate speeds. With commutating poles the flux may be 25 per cent or even 35 per cent less. A great many other curves are given concerning losses, efficiency, etc. The transformer efficiency curves are reproduced in Fig. 2. An account of the discussion which followed the paper is also given.—Lond. *Elec. Eng'ing*, Jan. 30.

*Air-Gap Correction Coefficient.*—P. H. Powell.—A note on some experiments on the air-gap correction coefficient. In an earlier paper open slots were dealt with, whereas the present investigation was devoted to partially-closed slots. The experiments were conducted on the stream-line method, and a number of photographs of the stream-lines obtained with sectional models of teeth of various proportions were taken, from the measurements of which the corresponding values of the required coefficient were deduced from 28 different cases given, values varying from 1.062 to 1.320. The chief factors determining the coefficient are the length of air-gap and the width of slot opening. The rounding of the corners is unimportant, as is also the width of iron in the lip of the slot, provided this width is above a certain limit. The ratio of the width of slot to width of tooth is of some importance. From a few typical examples of the stream-line photographs it was found that only a very small proportion of the lines manage to keep in the slot; this is very marked in comparison with some of the diagrams in the previous paper for open slots. As might be expected, the disturbing effect of the presence of the teeth on the distribution along the pole-face and in the pole shoe becomes more and more marked as the gap decreases.—Lond. *Elec. Eng'ing*, Jan. 30. A longer abstract, with illustrations, in Lond. *Elec.*, Jan. 31.

*New Winding for Polyphase Generators.*—F. Punga.—The author describes a winding which is stated to be very suitable for polyphase generators and which is claimed to have considerable advantages in comparison with ordinary polyphase windings, especially for a large number of poles and a high voltage at the terminals, without any detrimental effect on the wave form of the electromotive force. The number of slots is

Fig. 3.—Polyphase Generator Winding.

approximately one per pole per phase, but the chief feature of the new winding consists in the fact that while the stator is uniformly slotted a few slots are not provided with windings. For instance, for an eight-pole, three-phase generator there are provided 27 slots, which are symmetrically distributed around the circumference, but slots numbered 4, 13 and 22 are unused, while windings are placed in the others in the normal way as

indicated in Fig. 3. The author endeavors to show that such a winding is a perfect three-phase winding and that it has very considerable advantages over an ordinary three-phase winding. —*Elek. Zeit.*, Feb. 6.

*Cascade Converter.*—A. BLOCH.—An illustrated article in which the author describes in a simple way without much mathematics the operation of the Bragstad-LaCour cascade converter, and discusses its advantages.—*Elek. u. Masch.*, Feb. 2.

*Direct-Current Turbo-Dynamos.*—R. POHL.—The first part of a paper illustrated by diagrams on the development of direct-current turbo-dynamos. The paper appears to be essentially the same as the English paper recently published by the same author.—*Elek. Zeit.*, Feb. 6.

*Direct-Current Turbo-Generators.*—R. POHL.—An account of the discussion of his recent paper before the Leeds section of the (British) Inst. Elec. Eng. Various means of minimizing commutation troubles were discussed. Agreement was expressed with the author as to the impracticability of homopolar designs.—Lond. *Elec. Eng'ing*, Jan. 30.

*The Curve Form of the Currents in Three-phase Motors.*—K. SIMONS AND K. VOLLMER.—With the aid of an oscillograph it is possible to investigate phenomena in electric machines which are hardly accessible to mathematical analysis. The authors have determined with the oscillograph the wave forms of the electromotive force and current in three-phase motors with open slots as well as with closed slots. The form of the curves is discussed and on the basis of these results the different methods for separately determining the various losses in three-phase motors are critically discussed.—*Elek. Zeit.*, Jan. 30.

*Effect of Voltage Variation on Incandescent Lamps.*—F. HIRSCHAUER.—The relation between voltage and candle-power of an incandescent lamp may be given by the empirical formula $h = Ce^n$ where $h$ is the candle-power in hefner candles, $e$ the voltage, $C$ a constant for a certain lamp and $n$ a constant for lamps of the same type. Measurements have given the following values for $C$ and $n$:

| | | |
|---|---|---|
| Carbon filament lamp | $C = 3.7 \times 10^{-12}$ | $n = 6.3$ |
| Nernst lamp | $7.1 \times 10^{-20}$ | 10. |
| Tantalum lamp | $2.8 \times 10^{-8}$ | 4.3 |
| Osmium lamp | $7.5 \times 10^{-8}$ | 4.2 |
| Osram lamp | $3.4 \times 10^{-7}$ | 4.0 |
| Just tungsten lamp | $2.34 \times 10^{-7}$ | 4.0 |

This formula appears to give the relation between candle-power and voltage quite exactly. While the constant $C$ is of

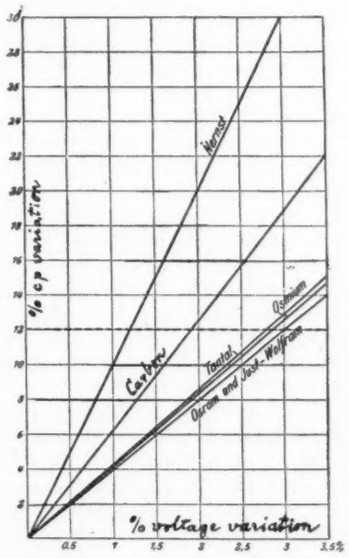



FIG. 4.—EFFECT OF VOLTAGE VARIATION ON INCANDESCENT LAMPS.

less interest, the figure $n$ is of great importance for the behavior of the lamps at varying voltage. If the voltage varies between two limits which are $p/2$ per cent above and $p/2$ per cent below normal voltage respectively, then the absolute variation of the candle-power between its two extreme values is $1/100\ n\ p\ C\ e^{-n}$ or the candle-power variation in per cents is $np$. This is diagramatically shown in Fig. 4. The formula shows that the candle-power variation in per cent for a given lamp and for a given percentage $p$ of voltage variation is constant and independent of the voltage at which the lamp is used; it depends only on the figure $n$. For a total voltage variation of 5 per cent the candle-power variation is 50 per cent for the Nernst lamp, 31.5 per cent for the carbon lamp, 21.5 per cent for the tantalum lamp, 21 per cent for the osmium lamp, 20 per cent for the osram lamp, 20 per cent for the tungsten lamp. The diagram enables one to find at once the voltage variation which may be permitted with an allowed candle-power variation. For instance, if a candle-power variation of 12 per cent is allowed, as is often the case with carbon-filament lamps, the points at which the dotted line in the diagram cuts the different lamp curves gives directly the permissible voltage variation. It is 1.2 per cent for the Nernst lamp, 1.9 per cent for the carbon lamp, 8.2 per cent for the tantalum lamp, 2.85 per cent for the osmium lamp, 3.0 per cent for the osram lamp and 3.0 per cent for the tungsten lamp. While on account of the smaller consumption of electric power per candle the electric conductors leading to metallic-filament lamps can be made thinner, the above figures show that their size may be still further reduced on account of the smaller sensitiveness of metallic-filament lamps toward voltage variation.—*Elek. Zeit.*, Jan. 30.

## Power.

*Gas Engines.*—F. W. BURSTALL.—His third report to the Gas Engine Research Committee of the (Brit.) Inst. Mech. Eng. The author describes experiments on a gas engine using very high compressions. The thermal efficiency was found to increase up to 43 per cent as the compression rose, but subsequently to fall off. It was also found that for a given compression a certain mean pressure exists giving the highest efficiency.—Lond. *Elec.*, Jan. 31.

*Cost of Power.*—An account of a discussion at the Glasgow section of J. F. C. Snell's recent (Brit.) Inst. paper on the cost of electric energy for industrial purposes. Several of the speakers took exception to Snell's paper.—Lond. *Elec. Eng'ing* Jan. 30.

## Traction.

*Single-Phase Railways.*—M. N. BLAKEMORE.—A table giving statistics on single-phase electric railways installed in this country during the past three years. The total number of roads in operation and in course of construction is 28, of which 19 were built by the Westinghouse Company and 9 by the General Electric Company. The total mileage is 966.3, which is simply the length of road, and does not take into account the fact that some roads may have two, three or four tracks electrified. Of this total mileage, roads with 691.8 miles are in electric operation and roads with 274.5 miles under construction. The total number of motor-cars is 240. The total number of locomotives is 57, the total horse-power of motors employed is 137,400. The longest single-phase road is that of the Indianapolis & Cincinnati Traction Company (116 miles), but the Spokane & Inland Railway Company (115 miles) is a close second. The line voltage is 1200 on one road, 2200 on two roads, 3300 on 10 roads, 6600 on 11 roads and 11,000 on four roads. The frequency is 25 with two exceptions: The Visalia Electric Railway Company uses a frequency of 15 and the Shawinigan Railway Company 30-15. On 13 roads both single-phase and direct-current systems are used. All of the roads are operated from a single catenary trolley with the exception of the New Haven road, which uses the double catenary line construction. The pantagraph trolley is almost exclusively used in this country, although a sliding bow trolley, somewhat similar to that so common abroad, has been tried, but is not so successful as the pantagraph type of trolley. This is due to the fact that the sliding bow trolley does not respond so readily to the varying heights of wire as does the pantagraph trolley. —*Elec. Jour.*, February.

*Storage Battery Traction.*—K. FUERST.—The storage battery cars installed on the Palatian railways having given good re-

sults the Prussian railways also equipped some cars with storage batteries in the Mainz district. These cars have been in use for about a year, and have proven satisfactory. Their construction and the charging plant at the station in Mainz are fully described, and the results obtained with this method of traction are given. It is found that on the basis of a yearly run of 34,000 kilometers per motor-car the cost per car-kilometer is approximately 9.73 cents.—*Elec. Zeit.*, Jan. 30, Feb. 6.

*Conduit System.*—F. R. Roose.—A paper read before the (British) Junior Institution of Engineers on the conduit system employed on the London County Council tramways, discussing the difference between early and present construction. —Lond. *Elec. Rev.*, Feb. 7.

*Overhead Conductors.*—An illustrated description of a new method of P. J. Pringle of supporting overhead conductors which is in use on recent extensions of the Derby municipal tramways. The writer first refers to former failures to develop an ear which does not interrupt the smooth passage of the trolley wheel, and states that it is possible to construct a soldered ear which will be satisfactory and that by soldering only the semi-circumference a non-fouling ear can be attached with an ample margin of tenacity to round wire of the smallest section in use. The method of suspension is then discussed, and it is claimed that in former methods a considerable sag has been created between supports and that the suspension has always been relatively inflexible. "Hitherto the almost rigid bracket-arm, or bow-string, or tight span wire has confined the trolley wire at the point of suspension both horizontally and vertically. The wire has been unable to cushion the blow of the trolley-wheel by rising to its pressure, and the wheel has struck it hard at the trailing end of the ear. It has been unable to transmit past its supports more than a small portion of the vibration set up by the trolley pole and wheel. Take now, a trolley wire anchored on both sides of a bracket-arm, and unscrew the hanger from the central ear. The wire floats, and is no longer cramped for movement in any direction. The supporting forces are now approximately tangential to the wire, and it is free. That, in effect, is Pringle's tangential suspension."—Lond. *Elec. Rev.*, Jan. 24.

*Electric Train Performance.*—W. S. Valentine.—An article pointing out the advantages of graphical methods in solving problems of electric train performance. The author describes a method in which by the use of a celluloid templet the amount of work entailed in the usual methods practiced by engineers is greatly reduced.—*Elec. Jour.*, February.

*Gear Ratios.*—Translations of two German articles, one by P. Gesing on the choice of railway motors as influenced by gear ratio, and the other by W. Bethge on the effect of gear ratio on energy consumption.—Lond. *Elec.*, Jan. 31.

*Railway Location.*—H. E. Wagner.—The author describes methods of locating a railway and the design of curve-turnouts, frogs and cross-overs.—*Elec. Jour.*, February.

*Electric Traction on Railways.*—P. Dawson.—A continuation of his very long illustrated serial. In the present installment the author passes on to the consideration of direct-current, three-phase and single-phase motors for railways and their characteristics.—Lond. *Elec.*, Jan. 31.

*Electrification of Railways.*—G. Kapp.—An abstract of his second lecture before the Royal Institution. He considers briefly the chief characteristics of the forms of the direct-current, three-phase and single-phase systems now in use.—Lond. *Elec. Eng'ing*, Jan. 30; a longer abstract, with illustrations, in Lond. *Elec.*, Jan. 31.

### Electrophysics and Magnetism.

*Influence of Temperature on Minimum Potential of Spark Discharges.*—P. Pringheim.—An account of an experimental investigation. The minimum potential of the negative point discharge when not illuminated is not an absolutely constant quantity, especially when the point is quite new. But after some time it assumes a value which is not only maintained for a very long time, but also, when changed by any influence such as heating or radium rays, always returns on restoring the original conditions. This permanent value applies especially to pressures below 500 mm. When the pressure is constant, and the point is heated above a red heat, the negative minimum potential is distinctly lowered down to a point which is not affected by further heating. This value is also restored on restoring its conditions. Some observations were also made concerning the manner in which the negative point discharge disappears. The minimum potential of the positive point discharge is, as a rule, very constant. The effect of heating under constant pressure is insignificant and there is no marked diminution above heating at a red heat.—Lond. *Elec.*, Jan. 31.

*Small Particles on a Nernst Filament.*—C. E. Mendenhall and L. R. Ingersoll.—In the course of a determination of high-temperament melting points the authors have noted several curious phenomena attending the heating of minute particles of various metals placed on the surface of a Nernst filament. The first phenomena are associated with an undercooling of molten globules. If a small particle of, say, platinum be placed on the glower, melted into a globule about 1/10 mm or 1/20 mm in diameter, and then allowed to cool either slowly or rapidly, it will not solidify at the melting temperature, but will remain very evidently fluid until a temperature is reached from 50 deg. to 300 deg. lower than the melting-point, when solidification will suddenly occur, accompanied by a quick "flash" or brightening of the drop. Upon reheating there is no flash and the drop melts at its proper melting temperature. The same general effect is observed with gold, palladium, platinum, silicon, rhodium and iridium. The authors conclude that the phenomena is simple one of exaggerated undercooling made possible by the very small mass of metal which assumes an approximately spherical shape. The flashing is not a direct luminescent phenomenon, but is due to the sudden increase in temperature resulting from the liberation of the latent heat of fusion. Quite distinct from these cases of undercooling are a number of cases of motion of various metals on the surface of the glower parallel to the current flow. The most striking of these is observed when a small particle of cobalt, say, is placed on the surface of a glower carrying a direct current. When the temperature is raised to about 1200 deg. C. it will commence a slow and regular end-over-end rolling motion along the glower, which changes in direction when the current is reversed, and which is not affected by holding the glower vertical, or, indeed by turning it completely upside down. While this phenomena has not been completely explained it appears that the forces involved are localized at the point of contact of the particle and glower.—*Phil. Mag.*, February.

*Positive Electrons in the Sodium Atom.*—R. W. Wood.—An article giving the results of experiments which show that some of the absorption lines rotate the plane of polarization in the positive direction while the others rotate it negatively. If the positive rotation at the *D* lines of sodium can be used as an argument that they are due to negatively charged electrons, it appears to the author that the two types of rotation in the channeled spectrum is an evidence that there are both positive and negative electrons in the atom. The experimental results, however, prove merely that some of the absorption lines give a rotation opposite to that given by the *D* lines.—*Phil. Mag.*, February.

*Roentgen Rays.*—C. G. Barkla.—A note on Roentgen rays and scattered Roentgen rays. The author's results afford strong confirmation of the electromagnetic pulse theory of Roentgen rays and of the theories of scattering and of polarization based on this. The scattering of "soft" Roentgen rays by substances of low atomic weight is almost perfect, while the radiation is very far from a purely scattered radiation when more penetrating rays are used. There is a small proportion of scattered rays in other secondary radiations.—*Phil. Mag.*, February.

*Determining Stream Lines and Equipotentials.*—L. F. Richardson.—Maxwell has already referred to tentative methods of altering known solutions of the well-known Laplacian differential equation by drawing diagrams on paper and selecting

the least improbable. The present author points out that this free-hand graphic way of determining stream lines and equipotentials can do far more than merely alter known results, and that it may be so far from tentative as to yield a result within 10 per cent of the correct value.—*Phil. Mag.*, February.

*Magnetic Rotatory Dispersion.*—R. W. WOOD.—A paper on anomalous magnetic rotatory dispersion of neodymium.—*Phil. Mag.*, February.

### Electrochemistry and Batteries.

*Calcium Cyanamide.*—J. B. C. KERSHAW.—An illustrated article giving a review of the electric furnace industry of calcium cyanamide.—Lond. *Elec.*, Jan. 24.

### Units, Measurements and Instruments.

*Regulating Resistor.*—C. FREDENHAGEN.—An illustrated description of a portable regulating resistor for laboratory use. It consists of 21 single ristors in series having a total resistance of 85.25 ohms, these being divided into five groups. By means of six levers sliding over contacts it is possible to regulate the resistance from 85.25 ohms down to 0.01 ohm in stages of 0.01 ohm.—Lond. *Elec.*, Jan. 24.

*Self-Inductance.*—E. B. ROSA.—An article on the calculation of the self-inductance of a coil of any length wound with any number of layers of wire. The method consists of several successive steps. First the self-inductance of the coil is calculated on the supposition that the depth of the winding is reduced to zero. Then a correction is applied to take account of the actual depth of the winding and finally another correction is made which takes into consideration the shape of the section of the wire, the thickness of the insulation, the number of turns of wire in the coil and the shape of the section of the coil.—*Bull. Bureau of Standards*, Jan. (Vol. IV, No. 3).

### Telegraphy, Telephony and Signals.

*"Loaded" Telephone Cables in Germany.*—The following table gives a review of the cable lines equipped with Pupin inductance coils which have been installed by the Siemens-Halske Company of Berlin:

| Cable. | Year of installation. | Length of cable in kilometers. | Copper diameter in mm. | Number of double wires. | Distance between successive inductance coils in km. |
|---|---|---|---|---|---|
| Berlin-Potsdam ..... | 1902 | 32.5 | 1.0 | 28 | 1.3 |
| Merida-Progreso (Mexico) | 1904 | 40. | 0.8 | 14 | 1.4 |
| Düsseldorf-Elberfeld .... | 1904 | 32. | 1.5 and 2.0 | 28 and 56 | 1.3 |
| Schoeneberg-Ragow ..... | 1905 | 28. | 0.7 | 3.5 and 7 | 1.4 |
| Berlin-Spandau ..... | 1906 | 18. | 0.8 | 56 and 112 | 1.75 |
| Berlin-Potsdam ..... | 1906 | 40. | 0.9 | 100 | 1.4 |
| Friedrichshafen - Romershorn (submarine cable in Bodensee) ..... | 1906 | 12. | 0.8 | 250 | 1.5 |
| Berlin-Wannsee ..... | 1907 | 25. | | | |
| Berlin-Köpenick ..... | in course of erection | 17. | 0.8 | 56 | 1.6 |
| Duisburg-Mülheim-Oberhausen ..... | in course of erection | 27. | 1.5 and 2.0 | 56 | 1.5 |

The above cables are stated to have been in uninterrupted service since their installation. With the exception of the Mexican cable, all of them are in Germany. The sumarine Bodensee cable and the difficulties in laying it have been noticed repeatedly in the Digest. The aggregate length of the above 10 cables is 271.5 kilometers, or 168.6 miles. For lexicographers it may be of interest to note that at one place the "loading" of a cable with Pupin inductance coils is called "pupinizing" the cable.—Circular 11 of Siemens & Halske Company of Nov. 21, 1907

*Pupin System of Telephone Lines.*—M. KLEIN.—A communication in which the writer points out that the damping coefficient alone does not determine the quality of telephonic transmission. It is not true that the increase of self-induction always means an improvement of telephonic transmission. The reason is that while the increase of self-induction decreases the damping coefficient it also decreases the current at the transmitting end. The author claims that in the case of the submarine Bodensee cable the transmission can hardly have been improved by the use of Pupin inductance coils if the theory is correct. The current at the receiving end of the Pupin cable is a function of the frequency, although the damping coefficient is independent of the frequency. The distortion of speech is changed, but is reduced quantitatively only to a small extent. A formula is given to show that for any cable which is to be equipped with Pupin coils, there is a certain limit of total cable length below which the use of coils is not useful but detrimental. In the case of the Bodensee cable this minimum length is from 12 to 15 kilometers, while in reality the cable is 12 kilometers long. The damping coefficient determines to what distance speech can be transmitted, but does not determine the quality of telephonic transmission over distances which are much shorter than the maximum possible distance. The writer believes that in the formula $al < 2$ the figure 2 is somewhat too low for determining the distance $l$ of transmission ($a$ being the damping coefficient). The German postal department (which controls the telephone lines) uses cables with air-insulated double conductors of 0.8 mm wires. With such cables it is possible to speak over a distance of 50 kilometers, and over a distance of 40 kilometers the transmission is still good. This gives $a = 0.09$ and $al < 3.6$.—*Elek. Zeit.*, Feb. 6.

*Continuous Oscillations.*—O. M. CORBINO.—A description of a method of producing continuous undamped electric oscillations, different from that of Poulson's arc method. It consists in coupling a series dynamo with a shunt motor, and does not require a condenser. The principle underlying the system is put as follows: "A shunt motor, having field magnets and armatures of laminated iron, when subjected to a sinusoidal e.m.f. at the terminals, behave as an inductive resistance, whose inductance may have a negative value. Hence such an apparatus is equivalent to an inductance connected in series with a capacity. For a certain value of the speed, the inductance and the capacity are independent of the frequency." At this speed, therefore, the impressed e.m.f. need no longer be sinusoidal. A dynamo is equivalent to an inductance and a negative resistance as far as the period of the entire system is concerned. The author gives formulas expressing the inductance, capacity and resistance of the whole combination and shows that the damping is, under suitable conditions, automatically compensated.—*L'Elettricista*, December, abstrated in Lond. *Elec. Eng'ing*, Jan. 30.

## BOOK REVIEW.

PROJEKTIERUNG VON ELEKTRIZITÄTSWERKEN. By Fritz Hoppe. Hannover: Max Jaenecke. 204 pages; 43 illustrations. Price, 3.8 marks.

It is not to be expected that an analysis of the cost of installations in one country can be applied without modification to installations in another country where conditions of labor, cost of material, etc., are greatly different. However, the fundamental laws of Nature are equally applicable in all countries. The information which the present volume gives relative to the performance of various types of prime movers, generating units and distributing circuits would prove of value to the American engineer, while the tabulations of the cost of operation and the income to be expected would be of no particular value to him except for purpose of comparing them with similar tabulations for this country. For the German engineer, the book contains a large amount of data which he can use to considerable advantage.

## Luminous-Arc Lamp for Constant-Potential Circuits.

The luminous metallic arc lamp is now recognized as a highly efficient and excellent all-around street illuminant for commercial use. This system of street lighting, having passed the experimental stage, is now in quite general use. For low-voltage, direct-current, constant-potential circuits, however, there has been but little use made of the luminous-arc lamp.

The General Electric Company recently placed on the market a luminous-arc lamp for operation on direct-current circuits at an e. m. f. of from 100 to 125 volts. The general form of this lamp can be seen by referring to Fig. 1. The casing is of solid copper with a black oxidized finish, and it is of sufficient

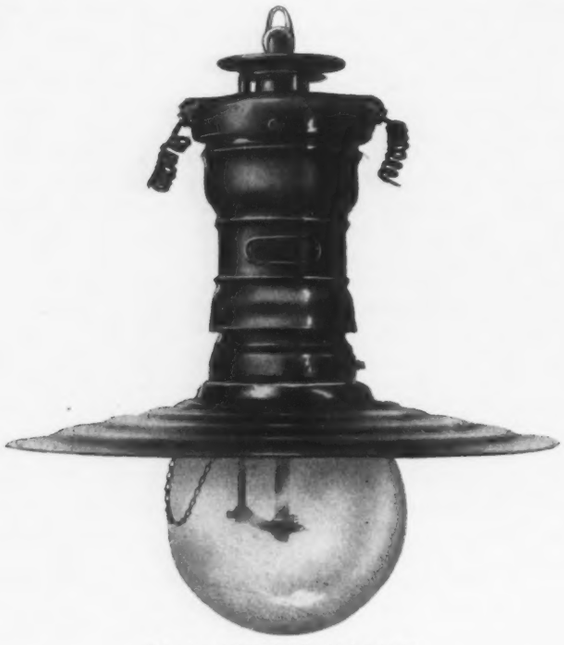


FIG. 1.—LUMINOUS ARC LAMP.

thickness to form a durable housing for the lamp mechanism, as well as a substantial support for the outer globe.

Fig. 2 is an interior view, showing the mechanical construction of the lamp. The main frame consists of a 1.5-in. iron pipe connecting the top and bottom castings. This construction is rigid and at the same time it provides a suitable center draught or chimney for disposal of the arc fumes. At the top the chimney

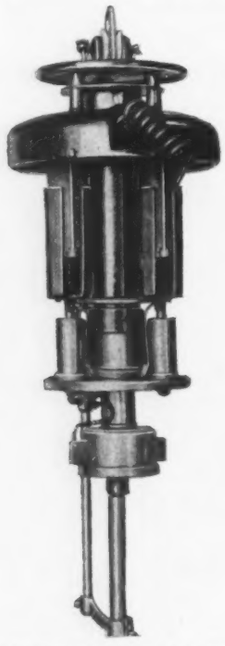


FIG. 2.—LAMP MECHANISM.

is protected from rain and snow in such a manner as not to interfere in any way with the natural and uniform draught required for the proper action of the arc.

The upper or positive electrode consists of a drop forging of copper. With a large volume of copper and a large radiating surface, it is possible to keep this electrode at a low temperature. This condition, together with the peculiar characteristics of the luminous arc, prevents a rapid wearing away of the copper. The copper electrode in a 4-amp. lamp will require renewal after about 1800 hours of operation; or with an average burning of 5 hours per day it will last about one year.

The lower electrode, which is responsible for the flaming characteristic of this lamp, is an iron tube about .75 in. in diameter filled with a magnetite composition. The life of the lower electrode is about 150 hours.

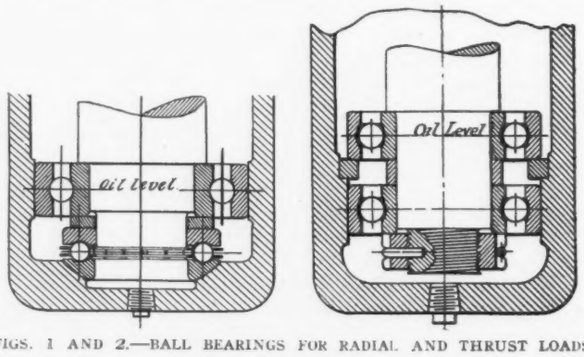
There are two single magnets, with two plungers mechanically connected. The action is positive and at the same time remarkably sensitive, responding quickly to any variations of the e. m. f. or the current, and thus a close regulation of the arc is maintained.

Photometric measurements show that a 4 amp. magnetite-arc lamp gives more light than a 5-amp. direct-current enclosed arc, or a 7.5-amp. alternating-current enclosed arc lamp. The characteristic light distribution of the luminous arc, with its maximum intensity near the horizontal, is well known. This natural distribution can be changed to meet other street lighting requirements by the use of correctly designed concentric wave reflectors.

In general, the lamp needs little attention; less, in fact, than the enclosed lamp, as there are no enclosing globes and gas caps to require careful handling, cleaning and renewing. The luminous-arc lamp is specially recommended for the lighting of foundries, machine shops, train sheds, freight houses, drill halls and riding academies.

## Ball Bearings for Vertical Shaft Lower End Journals.

The Hess-Bright Manufacturing Company, of Philadelphia, Pa., has among the many ball bearings manufactured by it some for vertical-shaft lower-end journals which take the radial and thrust load on the collar and radial bearings. One race has a close sliding fit in its seat and the other has a light driving fit. As a rule it is more convenient to have the outer race free.



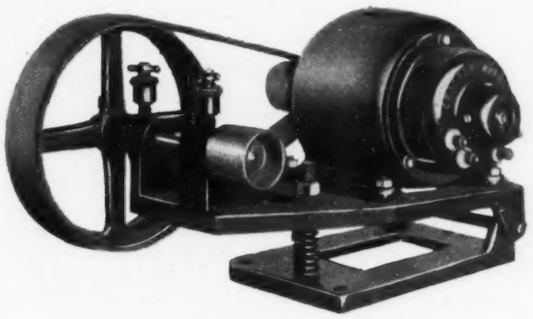

FIGS. 1 AND 2.—BALL BEARINGS FOR RADIAL AND THRUST LOADS.

The speeds that are practicable with collar bearings barely exceed 1500 r.p.m. and the carrying capacities for thrust of the collar ball bearings increase with decrease of speed. The arrangement shown in Fig. 1 takes the radial and thrust load on separate bearings. The washer between the two bearings prevents contact between the rotating plate of the collar bearing and the stationary outer race of the radial bearing, but when the collar bearing is not large enough to cause such contact, the washer may be omitted. The action of the spherical seat in compensating for deflections of the shaft and housing and inaccuracies of alignment is best when the center of the spherical seat lies as nearly as possible under the center of the radial bearing. The arrangement shown in Fig. 2 takes radial and thrust loads on separate radial bearings. In this arrangement the upper radial bearing is free circumferentially and so receives only thrust. The lower radial bearing as mounted is not subject to thrust, so that its full capacity may be applied to carrying radial load.

## Countershaft Belt-Tightener for Electric Motor.

A simple device for tightening the driving belt of an electric motor, which has been developed by the Crocker-Wheeler Company, is shown in the accompanying illustration. It consists of a countershaft and a simple and effectual belt tightener. Though designed for linotype machines, it can be used to advantage with any machinery requiring low-speed drive.

The motor and countershaft are mounted on a cast-iron base, which is pivoted at one end to a sub-base, the tension in the belt being produced by means of an adjustable nut at the other end. A spring is provided to support the movable base in case the belt breaks. The belt between the motor and the countershaft is tightened in the usual way, by shifting the motor on the movable base with the aid of an adjusting screw.



MOTOR WITH SPRING BASE COUNTERSHAFT.

It will be readily seen that the device is much more effective than a simple idler. Not only does it maintain the tension on the belt, but by the use of the countershaft a great difference between sizes of driving and driven pulleys is avoided, and the belt, therefore, makes contact with a greater arc of the driving pulley, with a consequent absence of slip.

## Electrically-Heated Glue Pots.

The Westinghouse Electric & Manufacturing Company has brought out a line of improved, electrically-heated glue pots that illustrate the application of electricity in the simplest and most convenient form. The pots are made in two-quart and four-quart sizes, in both portable and bench types.

The pots themselves are made of seamless drawn copper with brass bail and wiper rod. The water bath is made of seamless copper, and the heating element, which is wrapped around the lower portion, is enclosed in a water-tight tin envelope. The water bath is provided with a patent circulating device, which gives it the maximum heating efficiency. This device consists of a hollow ring, the lower end of which is closed by a diaphragm having a central opening. This confines the heating action to the thin film of water outside of the device, and sets up a rapid circulation in the water, which brings the glue up to the working temperature in a short time.

FIG. 1.—PARTS OF GLUE POT.

To promote economical heating, the pots are provided with heat-regulating switches, by means of which the glue can rapidly be brought to the desired temperature, and then maintained at that temperature at a lower value of current.

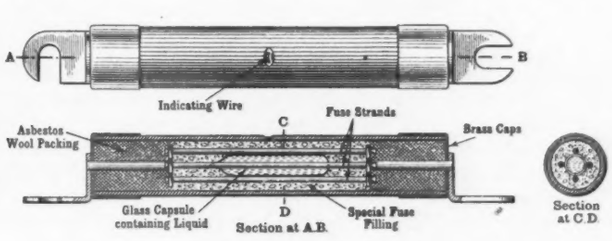
Fig. 1 shows the parts of the four-quart portable pot, including the water-circulating device. Fig. 2 illustrates the bench pot with the cover in place, and the unobstructed working surface on the bench. The glue pot and water-bath are hung underneath the table when not required, and when the pot is in use the cover may be likewise hung on the hook.

FIG. 2.—BENCH GLUE POT.

Electrically-heated, dry glue pots are made for those industries where the water-bath glue pot is undesirable.

## New Type of Enclosed Fuse.

As is well known, it is not an uncommon occurrence for an ordinary type of enclosed fuse to explode violently when subjected to a heavy short-circuit. This is due to the abnormally high temperature and high pressure produced within the fiber tube containing the filling by the sudden volatilization of the fuse metal, and if cooling is not rapidly effected, the enclosing tube cannot resist the heat and strain. Mr. E. B. Schattner, of the Electrical Apparatus Company, Caxton Building, London, S. W., England, has brought out a type of fuse in which the cooling of the arc is said to be effectively carried out under short-circuit conditions. The fuse resembles the ordinary cartridge fuse and is known as the "Koolark." Its make-up is clearly shown in the accompanying engraving. In addition to the usual filling surrounding the fusible strip, there is a glass capsule containing a special liquid. Under ordinary conditions the arc is damped by the filling in the usual way, but under a heavy short-circuit the pressure and temperature increase sufficiently to break and melt the capsule, thereby permitting the liquid to escape and to condense the generating gases. It is interesting to note that certain metals frequently used in enclosed fuses combine with the filling when subjected to a heavy short-circuit, with the result of making the interior of the fuse a solid conductor of a type similar to that used in producing the light in the Nernst lamp, so that a short-circuit




ENCLOSED FUSE.

may oftentimes be re-established. With the type of fuse illustrated, this silicating of the filling is said to be impossible under the most severe short-circuit. Tests made at the Deptford generating station of the London Electric Supply Corporation are said to have given excellent results. A series of short-circuits was made across a 500-kw, 550-volt generating set with various sizes of special "Koolark" fuses, the only other apparatus in circuit being a switch and a circuit-breaker set at 3500 amperes. The fuse in each case is said to have acted instantaneously without an appreciable noise and without tripping the circuit-breaker. The results were attributed to the cooling fluid set free at the time of the short-circuit, together with the special filling used. The fuse is manufactured in standard sizes for standard voltages and for any required current-carrying capacity.

## Polarity Flush Receptacles and Wall Plugs.

A new line of 20-ampere flush receptacles and wall plugs is being placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn., illustrations of which appear herewith. The devices embody the essential features of the 3-ampere plugs made by the same company, including the convenient interchangeable cap, but the porcelain parts and contacts are larger and stronger, in order to insure perfect safety for use on 250-volt circuits. While designed primarily for use with motors and the larger types of heating and cooking apparatus, their utility extends to

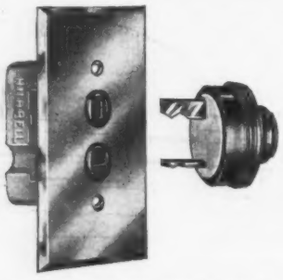


FIG. 1.—FLUSH RECEPTACLE.

any application where their features are desirable. The contact-post being set at right angles, they can enter a receptacle but one way, and reversal of polarity is thus rendered impossible. This feature is of especial value in connection with use on electrical indicators and experimental apparatus. The flush receptacles fit standard switch pockets. To prevent marring, the plate may

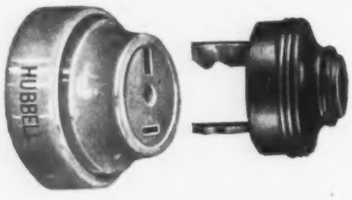



FIG. 2.—WALL PLUG.

be readily removed when a wall is being redecorated. The concealed cleat and molding wall plugs are especially convenient for use in connection with electrically driven machinery and tools. A snug-fitting metal casing covers the interchangeable cap, thus protecting the inner parts and making the whole practically indestructible.

## Remarkable Performance of an Induction Motor.

The general sturdiness and endurance of the induction motor under adverse conditions is proverbial, and the following incident illustrates the reason for their universal popularity.

A 5-hp, 440-volt, squirrel-cage General Electric induction motor was belt-connected to a centrifugal pump in the quarry of the G. H. Perry Company, Sioux Falls, S. D., the capacity of the pump being 158 gal. per minute when lifting about 45 ft. The motor was operated continuously during the rainy season, and was often allowed to run without attention during the night.

One Sunday morning an operator noticed that the quarry pit was full of water, the motor being partly submerged. The necessity of clearing the pit of water being evident, the current was turned on. To the surprise of all, the motor came up to speed and carried the load until the pit was clear, apparently none the worse for its prolonged bath. On examining the motor the next day, that portion of the paper pulley which had been under water was found to be softened and considerably warped out of shape. The motor gave excellent service until two months later, at which time it was completely destroyed in a fire which consumed several of the company's buildings. The simplicity, and consequent ruggedness of the induction motor was aptly expressed by the practical observer who said that it was a piece of shafting revolving between two hangers

## Recording Water-Level Gage.

In the gage illustrated herewith use is made of air pressure for transmitting the motion to the recording device, and it is claimed that thereby many mechanical difficulties found in practice have been overcome. There is located at the lowest point to which the water will fall a double bell casting between the halves of which there is placed a diaphragm of thin sheet rub-

RECORDING WATER-LEVEL GAGE.

ber so that the water pressure below compresses the air above; the pressure of the air is transmitted to the recording device through a flexible copper tube.

It is seen, therefore, that all moving parts have been eliminated except the rubber diaphragm, which is permanently located below the freezing point in the water. The recording portion may be located at any convenient distance from the water and can be equipped with either daily or weekly charts of almost any range.

These recorders have also been developed for registering the depth of oil in fuel-oil or storage tanks. When adapted as an oil-level gage a different form of casting is employed. In this the dividing rubber diaphragm is not used, thus eliminating the only element that would depreciate. The gages are made by the Bristol Company, 114 Liberty Street, New York.

# Industrial and Commercial News

## Commercial Intelligence.

THE WEEK IN TRADE.—Unsettled weather conditions during the last week were reflected by the general trade. Blocked railway traffic reduced the movement of grain to market to the smallest total in 22 months, and industrial operations were temporarily hindered. But the fall of rain and snow furnished a good covering for winter wheat and had an excellent effect upon the coal, rubber and similar lines of trade. The jobbing trade continues good, but country merchants are not buying more goods than they are sure they can sell. In the industrial world the shut-downs just about balance resumptions. Chicago reports that saving deposits have decreased about 8 per cent since last autumn, and talk of railroad wage reductions is general. The bank clearings show a heavy decrease from a year ago, but money is easy and collections are somewhat improved. The January exports, increased by heavy exports of wheat, wheat flour, cotton and oils, totaled but a fraction of 1 per cent behind the record month of last December. Imports were the smallest recorded in two and a half years, being 32 per cent smaller than the imports of January, 1907. The excess of exports over imports for January was the largest ever reported for any month. The total exports for the three months ending with January were valued at $617,806,048, a gain of 10 per cent over the same period during the preceding year, and compares with a total of imports of $288,889,604, an excess of exports of $328,916,444. A year ago the excess of exports over imports was but $81,659,569. Pig iron markets continue weak, and it is stated that independent interests in Pittsburg have reduced prices on steel billets from $28 to $26.75. In steel rails the demand is still light. The demand for structural material is fair. Wire and wire products continue in good demand. The leading interest, it is said, is operating to about 50 per cent of its capacity. Business continues fair in the electrical field. Large contracts are rare, but an increasing volume of inquiries promises increased activity in the near future. *Bradstreet's* reports 326 failures for the week ending Feb. 20, against 326 for the preceding week and against 177 for the corresponding week in 1907.

REORGANIZATION OF DEARBORN DRUG & CHEMICAL WORKS.—Robt. F. Carr and several of his associates in the Dearborn Drug & Chemical Works have purchased the holdings of the estate of the late Wm. H. Edgar, who died two years ago, and at a recent meeting of the stockholders, followed by a meeting of the directors of the company, the following officers were elected: Robt. F. Carr, president and general manager; Wm. B. McVicker, vice-president and eastern manager; Grant W. Spear and George R. Carr, vice-presidents; J. D. Purcell, assistant general manager; W. A. Converse, assistant secretary and chemical director; R. R. Browning, assistant treasurer; A. E. Carpenter, superintendent. Mr. C. M. Eddy's holdings were also taken over, he desiring to devote all of his time to his personal business interests. Robt. F. Carr became connected with the Dearborn Company following his graduation, in chemistry, from the University of Illinois, in 1893; for the past ten years he has been vice-president and general manager of the company. Mr. Wm. B. McVicker has been connected with the company for 13 years, having during most of that time been at the head of the Eastern Department; and for several years he has been second vice-president and eastern manager, at the general eastern offices in New York. Mr. G. W. Spear, who is a graduate in mechanical engineering, University of Illinois, entered the business in 1895. He has been one of the vice-presidents of the company for five years, in charge of the branch offices in the central district of the United States, having his headquarters in Chicago. Mr. George R. Carr has been connected with the company since he graduated from the University of Illinois, in chemistry, in 1901. He has occupied the position of assistant general manager of the company for the past four years, devoting his time largely to the railroad department of the business. Mr. W. A. Converse, who was elected to the position of assistant secretary, in addition to the office of chemical director, which he has previously held, has been in charge of the laboratories for the past 12 years. Mr. Converse has been secretary of the Chicago Section of the American Chemical Society for a long period. Mr. J. D. Purcell, the new assistant general manager, has represented the company in the railroad department for five years. R. R. Browning, assistant treasurer, has held a similar position for some years, having been with the company since 1896. Mr. A. E. Carpenter, superintendent, has had charge of the manufacturing department for many years, and is the oldest employee in the service of the Dearborn Company.

HIGHER PRICES FOR COPPER.—Senator William A. Clark sees no likelihood of any further marked decline in the price of copper, but believes that the price of the metal will be advanced before summer to a figure considerably above present prices. Speaking for him, a representative said: "The only conditions that would bring about a decline in the price of copper metal would be an increase in production with a simultaneous decrease in the demand. But while the mines are still producing at about the rate of production established last October, the consumption has increased, and the inquiries coming in seem to indicate a good business within the next few months. The copper market, like all markets, is obedient to the economic laws of demand and supply. When the enormous demand of 1906-1907 gave an opportunity to raise the price of the metal, every one got greedy and wanted to push prices higher and still higher. As a result, the metal reached a point where manufacturers would no longer buy copper in large quantities, and, naturally, the prices had to tumble. But the curtailment of the last few months has put the copper market in an excellent position. The unwieldly surpluses have been reduced by exports, to other shipments abroad, and the increase in orders and inquiries indicate a good spring business; that is, if the administration will leave the railroads alone and give them a chance to go ahead with their extensions and improvements."

AGENTS FOR UTAH COPPER COMPANY.—The Utah Copper Company has completed arrangements with the United Metals Selling Company whereby the latter will act as selling agent for the entire output of the copper company. Previously the Metal Selling Company had been acting as agents for the Utah Copper Company, but there was no contract between the two. The Utah Company, which has only recently entered the field as a large producer, claims that it will become one of the great copper factors of the globe. Its production in 1904 and 1905 was respectively 3,808,490 and 5,473,469 fine copper, and a rate of production is claimed of more than 50,000,000 lb. per annum before the close of the present year. Wall Street looks upon the transaction as additional evidence of the closer relations which now exist between the Amalgamated Copper interests and the Guggenheims. It is said that the contract will run for three years.

NAVY ELECTRICAL SUPPLY PROPOSALS.—The U. S. Navy Department asks proposals for furnishing a schedule of electrical supplies, the bids for which will be opened March 10. The schedule includes about 1300 electric bells and 15,000 feet of bell wire, large quantities of cable for interior communication, twin and single conductors and steel enameled conduits. Two hundred and thirty-seven thousand feet of the latter are required, and several hundred thousand feet of cable and conductors.

RIO DE JANEIRO ELECTRICAL SUPPLY HOUSE.—Mr. John B. Orr has opened in Rio de Janeiro a new four-story electrical supply house for the importation and exploitation of North American manufactures, and desires to receive from manufacturers of material, tools or apparatus used in or applying to any branch of the trade their catalogues with prices and export discounts. Mr. Orr has been engaged for 10 years in importing American goods into Brazil.

THE CHICAGO CITY RAILWAY has placed an order for 8000 tons of steel rails with the Lorain Steel Company, which involves an outlay of about $300,000. This duplicates a similar order of last year. Purchases of ties, paving materials, etc., will bring the total cost of road-bed improvements to $500,000.

THE COPPER MARKET.—The sudden decline in copper metal, followed by a recovery equally as sudden, was succeeded by another dip during the last week. The movements of the market have been not inaptly compared by a writer on copper to the fluctuations of an alternating current. Heavy selling by London longs, brought the price of lake copper down to 12¼ cents, which was ⅛ of a cent above the 12⅛ of last October, the lowest point touched by the metal since 1903. The announcement that the United Metals Selling Company had disposed of between 35,000,000 and 40,000,000 lb. at 13 cents or better, was received with incredulity. Even the low price induced but little buying, although it was conceded that the metal was cheap at that price. The absence of a speculative element, the poor outlook for money and the knowledge of available heavy supplies, kept the large consumers from breaking away from their policy of buying from hand to mouth; but under more favorable financial conditions it is more than likely that large contracts would have been placed. The statement of the available foreign visible supply, which has increased 1575 tons in the last two weeks, was a further deterrent to active buying here. The visible supply as compared with the supply at the same time in previous years is as follows:

| | |
|---|---|
| Feb. 15, 1908 | 22,175 tons. |
| Feb. 1, 1907 | 13,991 tons. |
| Feb. 1, 1906 | 10,951 tons. |
| Feb. 1, 1905 | 15,733 tons. |
| Feb. 1, 1904 | 14,233 tons. |

Covering by bear interest abroad together with the support given by the home market steadied the prices and brought about a slight rise toward the end of the week, but little confidence is felt in the situation, as it is believed that the London interests are still heavily long and are waiting only for a better market to throw over the larger part of their holdings. The total of the exports from Atlantic ports since the first of February is 17,245 tons, which is about 3000 tons below the exports for January for the same period. The present home consumption is estimated at about 10,000 tons a month, while the production and imports amount at least to 35,000 tons monthly. The week closed with the market steady around 13 cents, but with little prospect of any large contracts. Prices on the Metal Exchange on Monday closed as follows:

| | Monday. | Friday. |
|---|---|---|
| Lake copper | ..@13¼ | 13@.. |
| Electrolytic copper | 13@13⅛ | 13@.. |
| Castings copper | —@13 | 12.75@13 |

London metal prices:

| | Opening Monday. £ s. d. | Closing Monday. £ s. d. | Closing Friday. £ s. d. |
|---|---|---|---|
| Copper, spot | 58 0 0 | 57 17 6 | 58 7 6 |
| Copper, futures | 58 7 6 | 58 5 0 | 58 12 6 |
| Copper, best selected | 62 0 0 | 62 0 0 | 62 0 0 |

Extreme fluctuations for the year:

| | Highest. | Lowest. |
|---|---|---|
| Electrolytic copper, spot | 13¾ | 12¼ |
| Lake copper, spot | 13⅞ | 12⅜ |
| Casting copper, spot | 13½ | 12⅛ |
| London, spot | £64 5 0 | £56 12 6 |
| London, futures | 64 10 0 | 56 17 6 |
| London, best selected | 67 10 0 | 61 0 0 |

There seems to be no foundation for the report that the Amalgamated properties in Montana will resume operations by May 1. If such resumption is contemplated by the heads of the company in the East, it is not known in Butte; but it is likely that there would be as little intimation of the order to open the mines as there was to the closing order, which came when no one in the camp knew that there was any disturbance in industrial conditions. The copper world for some time has been watching with interest the mining developments in Utah and Nevada. From the porphyries of the Utah Copper and the Boston Consolidated in Utah and the Nevada Consolidated and the Cumberland-Ely in Nevada, there is promised a copper production of 125,000,000 lb. in 1909, and that before the close of the present year it is more than likely the production will total 75,000,000 lb. The Utah Copper Company claims to have already demonstrated that it can produce 3,000,000 lb. of copper a month and can produce it at 8 cents. This is the figure claimed for the Nevada Consolidated while the Cumberland-Ely it is claimed will produce copper at a price not exceeding 7 cents a pound. If these claims can be demonstrated the ultimate effect upon the copper stocks of the high-priced mines and the price of copper metal will be far-reaching.

LIGHTING DISCOUNTS.—In a recent editorial on the trend and results of investigations in the municipal lighting field, the *Progressive Age* makes the following caustic remarks as to electric lighting business methods: "Electricity supply companies are by no means in as good condition to stand investigation as gas companies. Their methods are more wasteful and founded less on safe business policy. They get the business, whether profitable or not, and give away much that should be paid for. They generally have a scale of prices resembling a mathematical puzzle. They mostly run along the ragged edge between profit and loss and through the displacement of machinery rendered necessary by new apparatus of much higher efficiency are frequently compelled to increase their investment. When electric properties begin to be investigated, generally with the same acrimony gas companies have experienced, they will no doubt be found less able to withstand the searching investigation. The question of charging system alone would condemn their methods; discount upon discount are so frequent that the actual value of current becomes simply a hazy impression which, carried a step further, would remind us of a story told of Mark Twain. That distinguished author and publisher entered a book store in which he was financially interested and purchased a book, asking for the usual trade discounts, publishers' discount, stockholders' discount, authors' discount, Mark Twain discount, etc., all of which were granted; the clerk figured out the discounts and informed the humorist that the company owed him 85 cents. The application is not at all far-fetched when the business of some electric companies is considered."

FURNACE PLANT EQUIPMENT.—The new Madeline blast furnace at Indiana Harbor has a fine power equipment furnished by the Allis-Chalmers Company, of Milwaukee. The boiler plant, situated directly back of the furnace, comprises eight 500-hp Sterling boilers, each with individual stacks. There are two pairs of Allis-Chalmers vertical long crosshead furnace blowing engines installed, designed to operate either singly or in compound condensing pairs. The steam may pass through a reducing valve when the low-pressure side is run singly. The power plant is further equipped with three Allis-Chalmers cross-compound Corliss engines, each direct connected to a 550-kw direct-current generator of the same build. The engines are uniform in type, having cylinders 20 in. and 42 in. x 42 in. stroke. Electrical energy is transmitted from the power house to a distributing station at the steel mills, a distance of about 1200 ft., by conducting cables supported on steel towers, to the property line of the blast furnace plant and from this point by underground conduit beneath the intervening tracks. In addition to the engines already enumerated there is installed in this plant an Allis-Chalmers horizontal cross-compound Reynolds Corliss pumping engine used for hydraulic transmission in the mills, operating lifts, stands and other handling apparatus. The water end of this unit has a capacity of 800 gal. of water per minute against a working pressure of 500 lb. per sq. in., under severe continuous service. In addition to numerous motors the plant includes electrical hoists and motor-driven trucks to handle ore. Mr. Arthur G. McKee, engineer, of Cleveland, designed and superintended the erection of the plant.

NEW ALLIS-CHALMERS PLANTS.—The Wolf Mill & Elevator Company, whose plant at Ellinwood, Kan., is being equipped with Allis-Chalmers flour mill machinery on the well-known "Universal Bolter" system, has purchased from the same builders power equipment driven by belting from a 12 and 24 x 36-in. cross-compound Reynolds-Corliss engine. Steam at 150 lb. pressure will be supplied from a Chandler & Taylor tubular boiler operated in connection with an open Stilwell heater and duplex hot water boiler feed pump. Stein-Hirsh & Company, operating a starch and gum factory at the corner of Ashland Avenue and Thirtieth Street, Chicago, is preparing to install an electric generator of 250 kilowatt capacity, direct-connected to a horizontal Reynolds-Corliss engine, the complete unit to be built by Allis-Chalmers Company. Three-phase 60-cycle current, generated at a pressure of 240 volts, will be distributed over the building for power and lighting. With this alternator there will be installed a 15-kw belted exciter of the same make. Adams & Schwab are consulting engineers, and Nimmons & Fellow, architects of the building.

NEW QUARTERS FOR GENERAL ELECTRIC COMPANY.—By the first of April the General Electric Company expects to be installed in its new quarters in the Hudson Terminal Building at Dey and Fulton Streets, New York. The offices of the company will occupy the whole of the seventeenth floor, with approximately 24,000 sq. ft. of floor space. The Edison Building at 44 Broad Street, which at present is occu-

pied in part by the General Electric Company, was built in 1891 by the Edison General Electric Company and sold by the General Electric Company several years ago. The Hudson Terminal Building, when completed, will be the largest office building in the world.

THE ROBINS NEW CONVEYOR COMPANY, which has been recently incorporated, will be operated under the management of Thomas Robins, who founded the Robins Conveying Belt Company in 1896, and was president of that concern until March, 1907, when its management passed into other hands. The position of chief engineer in the new company is filled by Mr. C. Kemble Baldwin, who has served in the Robins Conveying Belt Company in the same capacity for the last seven years. The offices of the company are at 38 Wall Street, New York, and 1240 Old Colony Building, Chicago.

## *Financial Intelligence.*

THE WEEK IN WALL STREET.—Reflecting the uncertainty for the immediate future felt on all sides, the stock market last week continued dull and unsettled, seemingly incapable of being much affected either by good or bad news. During the early part of the week a feeling of pessimism prevailed, which was partly dissipated when it was found that the market had been more or less sold out or oversold, and prices did not go lower, even under the sudden dip in the Gould stocks, a decline which has not been satisfactorily explained as yet. The letter addressed by President Roosevelt to the Interstate Commerce Commission, calling for the investigation of railroads which propose to reduce wages of employees, produced a distinctly bearish feeling toward railroad stocks, but the Chicago court decision, which temporarily, at least, gave the victory to Harriman in the Fish-Harriman controversy, was followed on Thursday by considerable covering and a sharp advance in Union Pacific and other issues of that group. The Interborough-Metropolitan issues were a weak spot in the market, there being apparent liquidation in the 4½ per cent bonds, carrying them down to the level of last autumn. Decline in the prices of copper metal, together with denials of stories of large sales to foreign interests, created bearishness toward Amalgamated. The week closed with the market firm and indicating a tendency to advance. Closing quotations of Feb. 24 were as follows:

NEW YORK.

| | Feb. 17 | Feb. 21 | | Feb. 17 | Feb. 21 |
|---|---|---|---|---|---|
| Allis-Chalmers Co..... | 6 | 5¾ | Interborough Met. com. | 7¼ | 6¾ |
| Allis-Chalmers Co. pfd. | 17 | 17 | Interborough Met. pfd. | 18¼ | 17¾ |
| Amalgamated Copper... | 46¼ | 47⅞ | Mackay Cos. ..... | 52 | 53 |
| Am. Dist. Tel..... | 39* | 39* | Mackay Cos. pfd..... | 58 | 60 |
| American Locomotive... | 33 | 32¾ | Metropolitan St. Ry... | — | 15 |
| Amer. Locomotive pfd.. | 88 | 89½ | N. Y. & N. J. Tel..... | 90 | 80 |
| American Tel. & Cable. | 55 | 44 | U. S. Steel com..... | 27⅝ | 28¾ |
| American Tel. & Tel... | 105 | 106 | U. S. Steel pfd..... | 91½ | 92¼ |
| Brooklyn Rapid Transit. | 38¾ | 40½ | Western Union Tel.... | 46¼ | 46¼ |
| General Electric ..... | 114 | 115 | Westinghouse com..... | 40½ | 39 |
| Hudson River Tel..... | — | — | Westinghouse pfd..... | 70 | — |

BOSTON.

| | Feb. 17 | Feb. 21 | | Feb. 17 | Feb. 21 |
|---|---|---|---|---|---|
| Amer. Tel. & Tel..... | — | 106¼ | Mass. Elec. Ry. pfd.... | 42 | 41 |
| Cumberland Telephone. | — | — | Mexican Telephone..... | — | — |
| Edison Elec. Illum.... | 205 | — | New England Telep... | 110 | 107½ |
| General Electric ..... | 114½ | — | Western Tel. & Tel..... | — | 6 |
| Mass. Elec. Ry..... | 11 | 10½ | West. Tel. & Tel. pfd... | — | 50 |

PHILADELPHIA.

| | Feb. 17 | Feb. 21 | | Feb. 17 | Feb. 21 |
|---|---|---|---|---|---|
| American Railways.... | 33 | 42 | Phila. Electric ..... | 5⅜ | 5⅝ |
| Elec. Co. of America.. | 8¾ | 8¾ | Phila. Rapid Transit... | 15 | 15 |
| Elec. Storage Battery.. | 26 | 26 | Phila. Traction ..... | 86 | 87 |
| Elec. Stor. Battery pfd. | — | — | | | |

CHICAGO.

| | Feb. 17 | Feb. 21 | | Feb. 17 | Feb. 21 |
|---|---|---|---|---|---|
| Chicago City Ry.... | 172* | 172½* | Metropolitan Elec. com. | 14 | 18* |
| Commonwealth-Edison .. | 84 | 85¼ | National Carbon ..... | 53 | 50 |
| Chicago Subway..... | — | 16 | National Carbon pfd... | 100 | 102 |
| Chicago Tel. Co..... | — | 110 | | | |

*Asked.

BELL TELEPHONE COMPANY OF PENNSYLVANIA.—The first report of the Bell Telephone Company of Pennsylvania shows a net gain of 7.14 per cent in stations, $925,931 increase in gross earnings, and $469,096 increase in expenses over the operations of the component companies for the previous year. The Bell Telephone Company of Pennsylvania was formed the latter part of 1907 to take over the Bell Telephone Company of Philadelphia, the Pennsylvania Telephone Company and the Delaware & Atlantic Telegraph & Telephone Company. The total number of stations operated at the end of the year were 225,405, of which 102,023 were in Philadelphia and 123,382 elsewhere. A dividend of 6 per cent was declared, and a balance of $500,333 carried to surplus. The capital stock of the company is $31,148,250, the bonded indebtedness $500,000. Since its organization, the company has taken over the Chesapeake & Potomac Telegraph Company by an exchange of capital stock on the basis of $100 for $150. This latter company operates 4296 stations in Washington, 3670 in Baltimore, and 592 elsewhere.

LAMP RECEIVERSHIP ENDED.—Application was made at Trenton, N. J., on Feb. 24, in the United States Circuit Court for an order terminating the receivership of the Westinghouse Lamp Company. The court approved the reports and accounts of the receivers and directed them to turn over to the company all the assets and property upon the company indemnifying the receivers against all claims arising out of any contracts entered into or approved by them. The court approved the settlements made by the company with its creditors, and it developed in the hearing that the liabilities of the company would be in the neighborhood of $300,000 and the assets about $2,300,000. The company has been four months in the receivers' hands. All of the capital stock of the company is owned by the Westinghouse Electric Manufacturing Company, of Pittsburg.

CANADIAN NIAGARA POWER.—It is stated from Canada that the Electrical Development Company, of Toronto, has passed into the control of Mr. William Mackenzie, the well-known traction magnate. The statement is made that he has taken hold to save it from liquidation, the hydro-electric policy of the Whitney Government having stampeded the British financiers. Be that as it may, the situation as it affects power for Toronto has changed, and there is an idea expressed by the local newspapers that Mr. Mackenzie may be able to come to an arrangement with Toronto that will render it unnecessary to duplicate a transmission line from the Falls or a distribution system in that city. This would probably affect seriously the government electrical scheme and policy.

UNITED POWER & TRANSPORTATION CO.'S ANNUAL REPORT.—At the annual meeting of the United Power & Transportation Co., of Philadelphia, the report for the year ending Dec. 31, 1907, showed an income from securities and loans of $840,119 against $824,021 for 1906. The expenditures for taxes, interest, etc., were $364,110, against $364,020 for 1906, leaving a surplus of $476,009, and a total surplus applicable to dividends of $743,098. The surplus for the year is equal to 13.24 per cent on the outstanding $3,593,750 capital stock. The retiring board of directors were re-elected.

PHILADELPHIA ELECTRIC STOCK.—The Philadelphia Electric Company notified the Stock Exchange that the dividends due to stockholders of record would not be paid until the first assessment is due, March 2. In consequence, the stock listing committee ruled that all transactions in the stock until that date should carry the dividend, the seller giving a due bill therefor. The stock will be quoted dividend on, and deliveries must be accompanied with a receipt for the dividend as per a form prescribed by the company.

CLEVELAND ILLUMINATING BONDS.—The Cleveland Electric Illuminating Company has sold to Spencer Trask & Company, of New York, $500,000 of its first and general 6 per cent gold bonds. This is part of an issue of $2,500,000 dated Jan. 1, 1908, and due May 1, 1913. It is said that perhaps half a million more of the bonds will be sold before the end of the year. The proceeds will be used to retire floating debt and pay for improvements which the company is making.

WESTINGHOUSE PROFITS.—It is noted that the net earnings of 41 per cent on the combined preferred and common stocks of the Union Switch & Signal Company, one of the oldest of the Westinghouse concerns, show it to be the greatest relative earner in the lot. Both the preferred and common stocks have been paying 12 per cent dividends. From 1904 to 1907 its net earnings increased from 14.4 per cent of the gross sales to 20.4 per cent.

TWIN CITY RAPID TRANSIT BONDS.—Wm. A. Reed & Company, of New York, have purchased $1,000,000 of the joint, 5 per cent, consolidated bonds of the Minneapolis Street Railway Company and the St. Paul City Railway Company, due 1928. It is stated that the proceeds are to cover improvements made on the roadbed, additions to the generating plant, etc.

# GENERAL NEWS

*Late items are printed unclassified at end of department*

## Construction News.

CENTERVILLE, ALA.—The Cahaba Power Company is planning to develop five water-power properties ranging from 400 to 1500 horse-power on the Cahaba River. The first plant will be built at Centerville, where about 7000 horse-power will be developed. The officers of the company are: H. E. Reynolds, president; W. L. Pratt, vice-president, and J. P. Kennedy, secretary and treasurer.

BISBEE, ARIZ.—The International Gas & Light Company has been purchased by the Bisbee Light & Power Company. A company has been organized under the laws of Arizona, which will be under the management of Edward M. Dean & Company, Grand Rapids, Mich.

HOPE, ARK.—The city has decided to increase the output of the water and light plant, and will construct a power house and install an engine and dynamo.

LITTLE ROCK, ARK.—The directors of the Little Rock Railway Electric Company have decided to extend the West Fifth Street line to the new state capitol building and to double track the entire Highland Park line.

MALMO, ARK.—The City Council has appointed a committee of three to make investigations in regard to installing an electric light plant and water works system. The committee is to make a report at the next meeting of the Council.

MARIANNA, ARK.—The local electric light plant has been purchased by Marshall Hewitt, who will operate the same.

AZUSA, CAL.—Owing to the rapid increase in the business of the Home Telephone Company in the Upper San Gabriel Valley, the company has decided to install an auxiliary station in Azusa to facilitate the work of the central exchange at Covina.

OROVILLE, CAL.—Plans are being made by the Northern California Power Company for the construction of two large power plants on Fall River in the Mooretown district. For one plant 2000 inches of water are available with a fall of 1,000 feet, and for the other a fall of 500 feet with 1500 inches of water.

SAN DIEGO, CAL.—Plans are being made to utilize the tides of False Bay to generate electricity. E. F. Schaniel and A. N. Jones have been granted by the County Commissioner the privilege of installing a tide motor at the outlet of the bay. It is proposed to furnish electricity in San Diego for lamps and motors.

SAN FRANCISCO, CAL.—Plans are being made for placing cluster lamps on ornamental poles on Main Street and the principal streets crossing that thoroughfare. The superintendent of the lighting department has been instructed to furnish estimates of the cost of the work.

WHITTIER, CAL.—The citizens of this city are considering the question of establishing a municipal electric light plant, and a committee has been appointed consisting of N. T. Edwards, chairman, C. F. Klingberg and H. E. Humphrey to formulate plans for the same.

DENVER, COL.—Plans have been filed in the office of the state engineer by D. A. Lord and M. C. Smith, New York capitalists, for the construction of a reservoir on Blue River, 15 miles above Kremmling, to cost about $750,000. The proposed dam will be 325 ft. high and 1700 ft. wide. The dam will furnish power to reclaim about 15,000 acres of valley land, and also to generate electricity which will be transmitted to cities, towns and mining camps within a radius of 100 miles.

WASHINGTON, D. C.—The Commissioners of the District of Columbia have approved a bill authorizing an extension of the Capital Railway line from the present terminus at Fifth and Nicholas Avenue, Congress Heights, to Shepherd's Landing.

ST. AUGUSTINE, FLA.—Mayor Masters has entered into a contract with the St. Johns Light & Power Company for lighting the streets of the city, from Jan. 15 to Oct. 1, 1908. The company is to furnish energy for 95 arc lamps and 65 incandescent lamps on a moonlight schedule at a total cost of $541.66 per month.

NEWNAN, GA.—The new municipal electric light plant was placed in operation Feb. 6. The output of the new plant is double that of the old plant. The equipment consists of two boilers with a total rating of 450 hp, a 350-hp Harrisburg engine and a 350-kw Crocker-Wheeler alternator. A 120-hp motor has been installed, which will be used to pump the city water supply from the reservoir, one and one-half miles distant.

STITES, IDAHO.—The citizens of this place are considering a proposition submitted by Benjamin Schultz, of Nezperce, to install an electric light plant and flouring mill in this town.

CARTHAGE, ILL.—Bids will be received until March 3 by J. W. Westfall, county clerk, for the electric lighting fixtures for the new court house. Joseph E. Mills, Washington Arcade, Detroit, Mich., is the architect.

CHICAGO, ILL.—The South Chicago Street Railway Company is installing an additional 400-hp Stirling water tube boiler in its South Chicago power house and is also erecting a smokestack.

CHICAGO, ILL.—The Commonwealth Edison Company is making arrangements to begin the construction of another generating plant which it is building on the south branch of the Chicago River. The contract for the construction of the building has been awarded to the Wells Brothers Company. The cost of the building and equipment is estimated at $750,000.

EL PASO, ILL.—The Grand Telephone Company has increased its capital stock from $11,000 to $18,000.

PEORIA, ILL.—The Peoria Railway Company has decided to place its wires underground in certain districts of the city, and to replace the wooden poles with concrete poles.

PEORIA, ILL.—Plans are now being made by the officials of the McKinley system for the construction of an interurban line between Peoria and Streator, which when finished will be the connecting link of a cross-country electric railway between Chicago and St. Louis, Mo.

BLOOMINGTON, IND.—The City Council has granted a 20-year franchise to the Citizens' Home Telephone Company, which was recently incorporated. The franchise provides for the annual payment to the city of $200 and furnishing free telephone service to the city departments. A contract for the construction and equipment of a plant will be let as soon as possible.

CRAWFORDSVILLE, IND.—The City Council has decided to improve the service of the municipal electric plant. It is proposed to secure the services of an electrical engineer to investigate the plant and ascertain what improvements are necessary and the cost of the same.

DUNKIRK, IND.—The order to sell the municipal light plant has been rescinded, the sentiment against such sale being too pronounced for the Council to proceed further. Extensive improvements will be made to the plant.

EVANSVILLE, IND.—C. M. Schank, general attorney of the Grand Central Traction Company, has filed an application for a franchise to operate its road in this city. Mr. Schank states that the company now owns 90 per cent of the right of way between Indianapolis and Evansville.

GOSHEN, IND.—The Winona Traction Company is preparing to extend its line north on Ninth Street to the factory district.

SULLIVAN, IND.—The Sullivan Electric Company has been placed under control of a receiver by Judge Henderson, on petition of William F. Poole, of Indianapolis, who holds claims calling for $4,000. The Marion Trust Company is named as receiver. W. A. Young, representing the trust company, states that no change in the local management is contemplated. The company recently expended a large amount of money in remodeling its plant, and hence the present embarrassment.

VINCENNES, IND.—The Vincennes Window Glass Company has renewed operation after a period of idleness. The factory will now, for the first time, be operated by electricity, natural gas being used for steam generation.

WHITE CLOUD, IND.—The Board of County Commissioners has granted to Julius Rothrock, of White Cloud, authority to erect transmission lines over the highways of the county for the transmission of electricity. Power for operating the system will be derived from the falls of the Blue River at the White Cloud Mills.

INDEPENDENCE, KAN.—The Independence Electric Light Company contemplates erecting 10 miles of pole line throughout the city and installing another 500-hp gas engine this fall. W. R. Murrow is secretary and manager.

IOLA, KAN.—Plans and specifications are being prepared by John Stanton, state architect, for the new power plant to be built at the State University, at a cost of $50,000. The mechanical laboratories of the engineering school will be housed in this building.

KANSAS CITY, KAN.—The merchants on Minnesota Avenue, who have applied to the City Council for a franchise to construct and maintain an independent electric light plant for the purpose of illuminating the business thoroughfares of the city, are contemplating making a general application and entering the field in opposition to other companies.

COLUMBIA, KY.—The local electric light plant, owned by W. R. Meyers & Son, has been purchased by Ray Conover. It is said that the new owner intends to enlarge and improve the plant and service.

COVINGTON, KY.—The officials of the Covington, Newport & Cincinnati Traction Company have made final arrangements for the construction of a new street car line between Covington and Newport, the cost of which is estimated at $30,000.

LEXINGTON, KY.—The Board of Aldermen has voted to authorize the Mayor to make a contract with the Lexington Railway Company for lighting the city for the year 1908.

LECOMPTE, LA.—Bids will be received at the office of J. R. Moore, mayor, until April 7 for the construction of an electric light plant. Plans and specifications are on file at the Mayor's office; at the office of A. B. Wood, 5026 Prytania Street, New Orleans, consulting engineer, and C. Scott Yeager, Alexandria, architect.

BANGOR, ME.—Acting under permission from Judge Putnam, of the United States Circuit Court, the receivers of the Bodwell Water Power Company are again furnishing the Eastern Manufacturing Company with electrical energy for operating its paper mill, under temporary arrangements.

OAKLAND, ME.—Fred Patterson, of Belgrade, has submitted a proposition to the Village Trustees to furnish electricity for lighting the town. He wishes to place a contract with the village to furnish 150 hp to be generated either by steam or water power. It is said that he will locate a plant at the upper dam.

BALTIMORE, MD.—Instructions have been given by the superintendent of lamps and lighting to the Consolidated Gas, Electric Light & Power Company for the installation of 120 additional arc lamps, 100 of which are to be erected in the business section of the city. For each arc lamp the city pays $67.49 per year, but where connection has to be made underground the city receives compensation for the use of its conduits amounting to about $10 a year on each lamp, which reduces the price to about $58 per year. All arc lamps in the business section of the city will be served with underground connections.

BOSTON, MASS.—The Finance Commission has appointed a subcommittee of its members to investigate and report upon the city's street lighting contract. The present contract with the Edison Illuminating Company for street lighting expires in February, 1909. Under it the city is paying $118 per lamp per year.

CHARLESTOWN, MASS.—It is reported that W. C. Myers is interested in the establishment of an electric light plant.

DANVERS, MASS.—In the report submitted by the special committee, recently appointed to investigate the condition of the municipal electric light plant, the committee endorses the plant, and recommends an appropriation of $23,500 for improvements and additions to the plant and service as follows: The installation of a compound condensing Corliss type engine, direct connected to a 300-kw, two-phase, 60-cycle, alternating-current generator; a motor-driven exciter and controlling switchboard; to concentrate the arc lamps in the central part of the town, and to place incandescent lamps in the outlying districts. It is proposed to sell the present three-phase generator. A proposition has been made as an amendment to consider changing the steam plant to a gas generating system, which was accepted by the committee.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company has announced a reduction in the rate for electricity to go into effect March 1, by which the majority of customers will make a saving of about 30 per cent. The present rate is 15 cents per kilowatt hour for all energy used. Under the new schedule the price will be 15 cents for the first 30 kw-hours and 8 cents for all used in excess each month.

PITTSFIELD, MASS.—The City Council contemplates asking the Stanley-G. I. Electric Manufacturing Company to bid on the city street lighting contract, which will be renewed in May.

SPRINGFIELD, MASS.—The New England Telephone & Telegraph Company contemplates the construction of a new exchange building to be erected at the corner of Stearns Park Avenue and Washington Street. H. S. Hyde is vice-president of the company.

TAUNTON, MASS.—The Board of Aldermen has adopted a resolution authorizing the manager of the municipal electric light plant to substitute incandescent electric lamps for the gas and naphtha lamps now in use.

MARQUETTE, MICH.—The Board of Light and Power Commissioners has decided to build a substation on Bluff Street, in accordance with the recommendation of C. W. Humphrey, of Chicago, Ill. The cost of the building, including machinery, is estimated at $12,000.

BAUDETTE, MINN.—It is reported that the Village Council is receiving bids for an electric light plant, to be installed at the pumping station.

ERSKINE, MINN.—The question of installing an electric light plant in this town is being considered. It will be operated as a private enterprise.

ST. PAUL, MINN.—The Twin City Rapid Transit Company has made arrangements to issue $1,000,000 in bonds, the proceeds to be used for improvements and for the construction of a new power house.

ST. PAUL, MINN.—W. C. Webber, president and general manager of the St. Paul, Minneapolis & Seattle Electric Railroad Company will soon begin construction of its road. The Co-operative Construction Company, of St. Paul, has been awarded the contract for the construction work. The company proposes to build a double-track, third-rail, electric railroad from St. Paul and Minneapolis to St. Cloud, thence to Fergus Falls, and from there to Fargo, N. D., with spur or branches running from the main line to adjacent towns or cities. It will also operate local traction lines in cities where feasible. The officers of the company are: William C. Webber, president and general manager; James W. Mossop, vice-president and general superintendent; David Phillips, secretary; S. A. Phillips treasurer, and Walter Townsend, chief engineer.

STEWARTVILLE, MINN.—The Stewartville Electric Light Company contemplates installing a new ideal engine and a 60-hp boiler in its plant. F. E. Alexander is secretary and treasurer.

OXFORD, MISS.—R. S. Adams, Mayor, writes that it is proposed to construct an electric light plant in Oxford, the cost of which is estimated at about $15,000.

FARMINGTON, MO.—S. L. Asbury, city clerk, writes that the city will construct a municipal electric light plant to cost about $25,000. Thomas B. Carter is engineer.

WEBB CITY, MO.—The City Council has granted C. U. Porter an extension of six months' time, during which he is to commence work on the proposed light and power plant in this city, for which a franchise was granted last summer.

HELENA, MONT.—It is reported that New York capitalists, who have built two dams near here, will construct another dam across the Missouri River. The new dam will develop 50,000 hp and cost approximately $2,000,000. The power will be utilized in the Butte-Helena mining district, and in pumping water to reclaim about 30,000 acres of land in the valley below Helena. M. H. Gerry is general manager of the company.

BLAIR, NEB.—The Blair Electric Light & Power Company will change its system to 60 cycles and install a three-phase, 60-cycle alternator, also a new engine and boiler. E. V. Capps is president and manager.

LONG PINE, NEB.—The Town Board has granted a franchise to I. Hewitt, of Neligh, to furnish electricity for lamps and motors in Long Pine and vicinity.

GARDNERVILLE, NEV.—A corps of surveyors in the employ of Carson and Gardnerville capitalists are surveying on the Carson River for an electrical power site. A large plant will be built to supply electricity to the towns of Carson, Gardnerville, Reno and Dayton, in opposition to the Truckee River General Electric Company.

KEENE, N. H.—John P. Rust has installed an electric power plant at his Water Street mills to furnish electricity to operate the mills.

CAMDEN, N. J.—The Public Service Corporation of New Jersey has submitted a proposition to the lighting committee of the City Council offering to enter into a contract for a period of five years, to date from July 1, 1909, to furnish energy for street lighting at the rate of $80 per arc lamp per year for 600 lamps or under. The city is at present paying $109.50 per lamp.

MORRISTOWN, N. J.—The Public Service Corporation has announced that it has secured additional land adjoining its present power station here and will erect an addition to its building and install new machinery.

MORRISTOWN, N. J.—The new plant of the Morris & Somerset Electric Company was started Feb. 10 and is now furnishing electricity for lighting the streets of the towns. Fifty-nine arc lamps are used in the center of the town; other streets are illuminated by incandescent lamps. The plant to date has cost $128,000. The new company furnishes energy for arc lamps at $85 per lamp year, and at $18 each for incandescent lamps. Peter V. Stryker is manager and treasurer.

SOCORRO, NEW MEXICO.—A movement is on foot to establish an electric light and power plant in Socorro and it is expected that the plant will be in operation in a short time.

ARCADE, N. Y.—The citizens of this village are contemplating the question of lighting the streets of the village with electricity. A committee has been appointed to ascertain the cost of constructing a plant to be operated by water or steam.

BATH, N. Y.—E. J. G. Tower, president of the Citizens' Electric Service Company, of Bath, writes that plans have been prepared to build an electric light plant in Bath to furnish electricity in Bath, Avoca, Savona and Kanona, covering a distance of 14 miles along the Cohocton Valley. The equipment of the plant will include two 200-hp producer gas engines direct connected to three-phase, 60-cycle alternators; a motor generator exciter set and a direct-connected, gas-engine exciter set. Substations will be erected in Avoca, Savona and Kanona. A day power service will be established and electrical energy furnished for motors at the rate of 3 cents per kw-hour. The price for electricity for lamps will range from 12 to 8 cents per kw-hour. The matter is now before the Public Service Commission of the Second District.

COEYMANS, N. Y.—The Town Board has petitioned the Public Service Commissioner at Albany for permission to allow the Atlantic Light & Power Company to do business in the town of Coeymans.

GOUVERNEUR, N. Y.—The Central New York Telephone & Telegraph Company is making arrangements to make improvements and extensions in its local plant and will install the common battery system.

LOWVILLE, N. Y.—The Black River Telephone Company, of Lowville, is planning to repurchase control of the property, which was transferred to the Independent Securities Company about three years ago. The capital stock of the company is $50,000, and the amount held by the Securities Company is $34,000.

NEW YORK, N. Y.—The Comptroller has been authorized to issue $15,000 in special revenue bonds for the purpose of rewiring and improving the lighting system of the City Hall.

BLUFFTON, OHIO.—William Plattner, manager of the municipal electric light plant, writes that the city is contemplating the reconstruction of its pole lines, etc.

CARTHAGE, OHIO.—The City Council is considering the question of erecting a new electric light plant. President G. A. Bauer, of the Board of Trustees of the old plant, has agreed to furnish arc lamps at $70 per lamp per year, and the Cincinnati Gas & Electric Company has submitted a proposition to furnish arc lamps at $60 per lamp per year.

MIDDLETOWN, OHIO.—Plans have been completed by the Middletown Telephone Company for the construction of a new telephone exchange in this city at a cost of $10,000. The contract for the construction of the building has been awarded to Bender Brothers.

MONTPELIER, OHIO.—A special election will be held March 16 to vote on the proposition of issuing bonds for repairing and enlarging the municipal electric light and water works plant.

NELSONVILLE, OHIO.—We are informed that the Nelsonville, Athens & Glouster Traction Company is planning to begin construction work in the spring. The company proposes to build an electric railway from Nelsonville to Athens, and from Chauncey to Nelsonville. The company has secured franchises in all the towns along the route, and also of the County Commissioners of Rocking and Athens Counties for rights over the county roads. The officers of the company are: L. F. Carpenter, president; C. W. Juniper, secretary, and Charles Tutt, general manager.

WARREN, OHIO.—The City Council is considering the question of constructing an electric light plant and waterworks system.

CLINTON, OKLA.—It is reported that an electric light plant will be installed in the town by parties who were recently granted a franchise.

CANBY, ORE.—A new power plant is to be erected by the Molallo Power Company on the Molallo River, about three miles from Canby. It is proposed to move the plant now located at Aurora and operated by steam to the new site and run it by water-power. The new plant will supply electricity to New Era, Canby, Macksburg, Barlow, Aurora and Hubbard. F. P. Hurst, of Aurora, is interested in the enterprise.

NORTH BEND, ORE.—It is reported that L. J. Simpson and Seymour Bell, of the Coos Bay Gas & Electric Company, will soon commence work on the construction of an electric plant at Porter to supply electricity in both Marshfield and North Bend for lamps and motors. The present plants in both towns will be held as emergency stations.

PORTLAND, ORE.—The Oregon Electric Railway Company is planning to place contracts during the next three months for construction of a substation and a branch line 21 miles in length from the main line to Hillsboro.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will extend its line to the site of the Swift packing plant as soon as the plants are well under way. It is also stated that the railway company will be prepared to supply Swift & Company with electric power for operating its plant if they should desire it. The line will either be extended from the present Vancouver line or a direct line will be built.

PORTLAND, ORE.—The officials of the Mount Hood Power Company have notified Mayor Lane that the company will be prepared to furnish electricity for street lamps in the city by Jan. 1, 1909, and asks for an opportunity to put in a bid for the city lighting contract.

PRINEVILLE, ORE.—Arrangements have been m de by H. V. Gates, of Hillboro, manager of the Prineville Light & Water Company, with the Reschutes Irrigation & Power Company to install a 2000-hp electric generating plant at Lava Falls, six miles south of Bend. Work on the construction of the plant is to begin within two months.

GREENVILLE, PA.—Franchises have been asked of the council of Greenville and Sharon by capitalists interested in the proposed electric railway, which is to connect Greenville, Mercer, and Sharon. The Greenville line is to be built first, to be followed by the Sharon-Mercer line.

JOHNSTOWN, PA.—Arrangements are being made to reorganize the Dale Light, Heat & Power Company, and it is expected that some changes will be made in the management of the plant. New equipment will be purchased and other steps taken to insure satisfactory service. George E. Daniels is at present president and manager of the company.

MORGANZA, PA.—Bids will be received until March 3 by the Board of Managers of the Pennsylvania Reform School for installing an electric light plant in the present power house. Proposals will be received on two steam engines, each direct connected to a generator. The engines are to be 125 hp each and the generators 75 kw each.

PEN ARGYLE, PA.—A proposition is being considered to have the Northampton Traction Company build a branch to extend from Ackermanville to Pen Argyle, a distance of four miles.

PENNSBURG, PA.—The Pennsburg Electric Light Company has decided to accept the proposition of the Columbia Silk Company, in East Greenville, to supply electricity for lighting the company's mill, provided the Columbia company erects the wires through East Greenville.

RIVER POINT, R. I.—An electric light plant is to be installed in the Valley Queen Mill, at River Point to furnish electricity for lighting the mill. It is expected that electricity will soon replace the oil lamps now in use in the Royal and other Valley mills owned by B. B. & R. Knight.

HILL CITY, S. D.—The Hill City Electric Power & Mining Company has decided to install an electric light and power plant.

KNOXVILLE, TENN.—The Knoxville Power Company has filed an application for an amendment to its charter, increasing its capital stock from $100,000 to $150,000. John Bogart, New York, N. Y., is chief engineer of the company.

BROWNSVILLE, TEX.—The plant and holdings of the Matamoras & Santa Cruz Street Railway Company have been purchased by Henry E. Scott, Samuel Fordyce and other stockholders of the Union Trust Company, of St. Louis, Mo. The purchase includes all the holdings of the ferry company and tracks at Santa Cruz. It is understood that the present mule car line is to be operated by electricity. The same parties also own the Rio Grande railroad running from Brownsville to Point Isabel, which it is said will later be converted into an electric railway.

NAVOSTA, TEX.—Plans are being considered for the construction of a new electric light plant in this city.

SAN ANGELO, TEX.—Col. J. H. Ransome is making arrangements to begin work on the construction of the power house of the proposed street car system.

RICHMOND, VA.—The Virginia Passenger & Power Company is now installing a new system of street lamps. The company was recently granted a contract for lighting the streets of the city for a term of five years at $54 per lamp per year.

RICHMOND, VA.—The joint committee on water and electricity has appointed a special committee to secure plans and specifications for a new lighting plant at the old pump house. The committee consists of Aldermen Mann, Satterfield and Dabney and Councilmen Mills and E. D. Richardson and City Engineer Bolling. The sum of $6,000 has been appropriated for this purpose.

ROANOKE, VA.—The Roanoke Railway & Electric Company has been granted franchises by the city to extend its Belmont line in the southeast section of the city; also for an extension of the Franklin Road line, and for a new line into the southwest section of the city. It is planned to do the work during the coming summer.

SUTTON, W. VA.—The Sutton Electric Light, Power & Water Company has been awarded a contract by the Council to furnish the town with electricity and water for a term of 25 years. By the terms of the contract the company is to furnish the first 12 lamps for $75 each per year; $60 each for the next 10 lamps, and $50 per lamp for all in excess of 22 lamps. The contract gives the town the privilege of purchasing the entire plant at the expiration of 25 years.

ARCADIA, WASH.—It is stated that as soon as spring opens active work will begin on the development of the Arcadia power plants of the Arcadia Company. Valuable water power rights have been secured by the company on Trout Creek, the Little Spokane and other streams in the vicinity of Horseshoe Lake. It is said that the company will furnish electricity for lamps to several of the towns near Spokane in the vicinity of Deer Park.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company will soon commence work on the construction of a new line to be built from the present terminus of the Dock Street line to the western boundary of Eureka addition, a distance of about two miles.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company is making arrangements to extend its lines to the Fair Grounds.

SEATTLE, WASH.—F. X. Waldron & Company, of this city, are promoting an electric railway to run from Seattle to Tacoma by way of Vashon Island. The cost is estimated at $350,000.

SEATTLE, WASH.—The Seattle Electric Company will expend about $1,500,000 in improvements, extensions and new equipments at its power plant at Georgetown.

SPOKANE, WASH.—The New World Reduction & Power Company is engaged in the construction of a 300-ton smelter in Park County, Mont., and is also installing a 15,000-hp electrical plant. J. R. Brown, of Spokane, is president of the company.

VANCOUVER, WASH.—The Home Telephone Company is making plans to erect an exchange building in this city at a cost of about $15,000.

WENATCHEE, WASH.—The Wenatchee Canal Company has decided to replace the overhanging flumes with tunnels and ditches in the rock; 2 miles of tunneling and filling of gulches will also be necessary. A water-power plant is to be constructed at the head of the canal and hydraulic pumps will be installed in the gulches.

HUNTINGTON, W. VA.—A franchise has been granted to H. H. Hughes to furnish electricity for commercial lighting for a term of 50 years.

JUNEAU, WIS.—The Dodge County Commissioners have decided to install a heating and electric plant at the County Insane Asylum.

LOYAL, WIS.—J. M. Philpott, village clerk, writes that the citizens have voted to issue $17,000 in bonds for an electric light plant and waterworks system. W. G. Kirchoffer, Vrooman Building, Madison, is the engineer.

SHEBOYGAN FALLS, WIS.—Bids will be received by the president and Village Trustees until March 16 for establishing and maintaining an electric light plant for a term of 25 years.

WAUSAU, WIS.—The Wausau Street Railway Company has purchased the water power of Little Bull Falls at Mosine, and proposes to improve the plant as soon as possible and develop between 4000 and 5000 horse-power. The company will furnish electrical energy for motors to manufacturing concerns.

VIOLA, WIS.—Plans are being made by E. R. Cushman for the construction of an electric light and power plant, the cost of which is estimated at from $15,000 to $20,000.

KEMMERER, WYO.—The Kemmerer-Big Piney Telephone Company contemplates many improvements and extensions to its system in the spring and is now advertising for about 3000 poles to be delivered along the line.

CHEYENNE, WYO.—C. T. Johnston, state engineer, has denied the application of the Big Horn Power Company for permission to erect a 60-ft power dam in the south end of the canon of the Big Horn River, as it would interfere with the railway rights-of-way through the canon. It is said that a permit would be granted for the erection of a 35-ft. dam, and it is expected that the Big Horn Power Company will erect a dam on the modified scale.

HAMILTON, ONT.—The special committee appointed to deal with the power question has decided to recommend the Council to employ an expert to draw up plans and specifications for the proposed street lighting plant.

PETERBOROUGH, ONT.—The Northumberland Power Company has applied to the Dominion Government for a lease of the Upper Healy Falls, where the company proposes to develop water-power.

LADYSMITH, B. C., CAN.—The Citizens' League has started an agitation for an electric lighting system here. The Council will take the matter up at the next meeting.

NELSON, B. C., CAN.—Cecil P. Smith, of Toronto, Ont., has been retained by this city to supervise the construction of the proposed power plant.

MONTREAL, QUE., CAN.—Application has been made to the Quebec Legislature by the Saraguay Electric Light & Water Company for incorporation and power to take over the Saraguay Electric Light & Power Company and to carry on a general business as an electric light company.

ABERDEEN, SASK., CAN.—The Aberdeen & Rural Telephone Company has been formed to take over the local telephone system. A new switchboard will be installed at once. C. J. Crawford is manager, and W. Jinnite secretary-treasurer.

SELKIRK, MAN., CAN.—The Winnipeg Electric Company has offered to supply this town with electricity for lamps at the rate of 10 cents per kw-hour with discounts of 10 per cent up, according to the amount used. Wilford Phillips is general superintendent, Winnipeg, Man.

CHIHUAHUA, MEX.—The Kansas City, Mexico & Orient Railroad Company has acquired what is known as the O'Gorman concession and plans to construct a large hydro-electric plant to develop from 5000 to 6000 hp. The plant will furnish electricity to operate the railroad through the most difficult part of the Sierra Madre, and will also furnish electrical energy to the mines in that region.

HERMOSILLO, MEX.—W. T. Christman, superintendent of the local electric light plant, owned by Ramon Carrol, of Mexico City, writes that a Reliance engine manufactured by the Allis-Chalmers Company, of Milwaukee, Wis., will soon be installed in the plant. He also states that it will soon be in the market of a belt-driven, 120-kw, 2200-volt, 133-cycle generator, complete with exciters, switchboard, panels, etc. Bids are also being received for 80 enclosed, alternating-current arc lamps to take the place of the open arc lamps now in use; also two 50-lamp transformers, with regulators, switches, panels, etc., complete.

TEXMELUCAN, MEX.—The Empresa de fuerza y lux de Chautla has under construction two new power stations, and also has a water power of 1500 hp undeveloped, which will probably be utilized in the near future. Harold J. Rossi is general manager.

## New Industrial Companies.

THE KENT TELEPHONE, SEAL & LOCK COMPANY, of Kent, Ohio, has been incorporated with a capital stock of $10,000 by F. J. Page and others.

THE PONTIAC EXPLORATION COMPANY, of Monteral, Que., Can., has been organized for the purpose of building telephone lines, etc. Address H. L. Dinning, Lachine, Que.

THE ENGINEERING & MAINTENANCE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $25,000, by R. E. Martinez, E. J. Hampton and W. J. White, to engage in engineering and electrical business in San Francisco.

THE ELECTRICAL MUSIC TRANSMITTING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000. The incorporators are: Mark Elsner, Isaac W. Goodhue, of New York; Jacob O. Goldstein, of Brooklyn.

THE CURRENT SAVING ELECTRIC LAMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The incorporators are Robert S. Kennedy, of New York; Daniel W. Moor, of Richmond Hill; Harry D. Hooge, of Ocean Grove, N. J.

THE THURSTON ROWE COMPANY, of Boothbay Harbor, Me., has been incorporated with a capital stock of $10,000 for the purpose of dealing in machinery, electrical supplies, hardware, etc. The officers of the company are: H. T. Thurston, president; S. E. Rowe, treasurer.

THE TESLA NITRATES COMPANY has been organized at Portland, Me., for the purpose of producing nitrogen compounds and other chemical substances by electricity. The company is capitalized at $500,000 and the officers are: James E. Mantor, of Portland, president; Clarence E. Eaton, of Portland, treasurer.

## Company Elections.

LITTLE ROCK, ARK.—At the annual meeting of the Little Rock Electric Company the following named officers were elected: W. E. Hemingway, president; Oscar Davis, vice-president; George D. Rose, secretary, and D. A. Hegarty, treasurer and general manager.

REDLANDS, CAL.—At the annual meeting of the Southwestern Home Telephone Company the following named officers were elected: K. C. Wells, president; A. Gregory, vice-president; C. H. Breckinridge, secretary. The company has purchased the lines and business of the Pacific States Telephone Company in this territory, and is planning many extensions in various directions.

BLOOMINGTON, ILL.—At the annual meeting of the Kinloch Telephone Company the following named officers were elected: John T. Lilliard, president; C. Marquand Forster, vice-president; Hart F. Farwell, secretary and manager, and August Gehner, treasurer; Marion B. Farwell, assistant treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the East St. Louis Railway Company officers were elected as follows: C. M. Clark, president; L. C. Haynes, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the St. Louis & East St. Louis Electric Railway Company the following-named officers were elected: L. C. Haynes, president; J. C. Van Ripper, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and treasurer.

LIBERTY CENTER, IND.—At the annual meeting of the Liberty Center Telephone Company the following named officers were elected: Perry Mounsey, president; L. A. Minnear, secretary, and William Arnold, treasurer.

COUNCIL BLUFFS, IA.—At the annual meeting of the Interstate Telephone Company, the following named officers were elected: W. A. Smith, president; H. M. Silsby, secretary and treasurer; F. M. Terry, S. A. Spooner, John Young, W. A. Smith and J. S. Dewell, directors. The company has purchased the Missouri Valley exchange, which gives it a system of about 800 rural and town telephones in the eastern part of this county.

LOUISVILLE, KY.—At the annual meeting of the Home Telephone Company the following named officers were elected: C. C. Bickel, president; Helm Bruce, vice-president; George M. Boone, secretary and treasurer.

JACKSON, MICH.—At the annual meeting of the Citizens Telephone Company the following named officers were elected: J. C. Richardson, president; E. W. Barber, vice-president; E. B. Fisher, secretary and manager, and C. E. Tarte, general manager.

ST. LOUIS, MO.—At the annual meeting of the Kinloch Long-Distance Telephone Company the following named officers were elected for the ensuing year: William D. Orthwein, president; C. Marquand Foster, first vice-president; August Gehner, second vice-president; H. Linton Reber, secretary and general manager; H. G. Fadeley, treasurer; William H. Bassett, assistant secretary, and James Harrison, chief engineer.

LAMBERTVILLE, N. J.—At the annual meeting of the Lambertville Heat, Light & Power Company officers were elected as follows: H. C. Case, president; S. C. Case, vice-president and secretary; M. N. Willits, Jr., treasurer, and H. M. Moorhead, general manager.

COLUMBUS, OHIO.—At the annual meeting of the Columbus Citizens' Telephone Company the following named officers were elected: Henry A. Lanman, president; Frank A. Davis, vice-president and counsel; Edwin R. Sharp, secretary and treasurer, and Gansey R. Johnston, general manager.

TOLEDO, OHIO.—At the annual meeting of the Toledo Home Telephone Company the following named officers were elected: James S. Brailey, Jr., president; R. E. Hamblin, vice-president; Thomas H. Walbridge, treasurer.

PATASKALA, OHIO.—At the annual meeting of the Pataskala Farmers' Telephone Company the following directors were elected: D. S. Snider, William McCormack, J. O. Pryor, C. N. Alward, John M. Beem, E. D. Moore, Jr., and Henry Brooke.

BELLOWS FALLS, VT.—At the annual meeting of the Fall Mountain Electric Light & Power Company the following-named officers were elected: James H. Williams, president; L. J. Royce, vice-president and general manager; R. L. Russell, treasurer, and E. L. Rantoul, assistant treasurer.

GRANTSBURG, WIS.—At the annual meeting of the Farmers' Independent Telephone Company the following-named officers were elected: Robert C. Anderson, president; A. Cassel, vice-president; F. R. Huth, secretary, and Emil Swenson, treasurer.

OSSEO, WIS.—At the annual meeting of the Beef River Valley Telephone Company the following named officers were elected: John Ring, president; Albert H. Larson, vice-president; Paul Kay, secretary, and A. A. Myhre, treasurer.

SPOONER, WIS.—At the annual meeting of the Spooner-Evergreen Valley Telephone Company the following-named officers were elected: Peter Brown, president; Levi Ailport, vice-president; George W. Harmon, secretary, and J. D. Thomas, treasurer.

LARAMIE, WYO.—At the annual meeting of the Little Laramie Telephone Company the following named officers were elected: John Reid, president; O. Wallis, vice-president; John W. Ernest, secretary; J. H. Farr, treasurer, and Samuel Coen, manager.

SELKIRK, ONT., CAN.—At the annual meeting of the Erie Telephone Company, the following directors were elected: S. W. Winger, Springvale, Ont.; W. Nablo, Kohler, Ont.; F. Hoover, Selkirk, Ont.; Chas. Reichfield, Fisherville, Ont.; W. J. Quinsey, Cayuga, Ont.; W. H. Davidson, Nanticoke, Ont.; A. E. Hoover, Selkirk, M. F. Derby, Selkirk Ont.

## New Incorporations.

EUREKA, CAL.—Articles of incorporation have been filed for the Humboldt Water & Light Company, with a capital stock of $750,000, by H. C. Seward, B. F. Fink, E. G. Pluke, J. N. Lentell, all of Eureka, and N. H. Falk, of Arcata. The company proposes to build and operate water works systems, electric and gas plants, etc.

OAKLAND, CAL.—Articles of incorporation have been filed for the San Francisco & Bay Counties Railway Company. The company is capitalized at $250,000 and the incorporators are: F. M. Smith, F. C. Havens, E. A. Heron, George E. Pratt and Dennis Searles. The company proposes to construct and operate an electric railway between Oakland and San José.

SAN DIEGO, CAL.—The Del Mar Water, Light & Power Company has filed articles of incorporation. The San Luis Rey power and Warner's ranch will probably be developed. Among the directors are C. A. Canfield, of Los Angeles, and Ed. Fletcher, of San Diego.

CANTON, ILL.—The Illinois Heating, Light & Power Company has been incorporated with a capital stock of $25,000 by J. D. Robertson and others.

EVANSVILLE, IND.—The Evansville, Mount Carmel & Olney Interurban Company has been incorporated for the purpose of building an electric railway from Evansville to Olneyville, Ill. The directors are: Aden Knopp, of Olney, Ill., president; G. W. Courter, of Mount Carmel, secretary; C. J. Seibert, E. O. Lockyear, Jacob Laubscher, of Evansville; E. B. Bixley, Thomas Newell, of Cynthiana; J. O. Smith, J. F. Seibert, of Lancaster; Aden Knopp, J. F. Hyatt, F. N. Boyer, of Onley.

AINSWORTH, IA.—The Ainsworth Telephone Company has filed articles of incorporation with a capital stock of $10,000.

RANDALIA, IA.—Articles of incorporation have been filed for the Fayette County Mutual Telephone Company with a capital stock of $10,000.

GLASGOW, KY.—Articles of incorporation have been filed for the Union Telephone Company with a capital stock of $1,500 by W. E. Taylor, W. G. Tooms, and Charles W. Noran.

LA CENTER, KY.—A new telephone company has been organized in this city to compete with the Cumberland Telephone Company. The company is capitalized at $25,000 and the officers are: T. M. Baker, president; W. H. Viets, vice-president, and Samuel McGee, secretary and treasurer.

HARLOWTOWN, MONT.—Articles of incorporation have been filed for the Harlowtown Light & Power Company, with a capital stock of $30,000 by Benjamin Urner and others.

CAMBRIDGE, NEB.—The Cambridge-Holbrook Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: Elmer Amon, Philo Hilton, and others.

EDDYVILLE, NEB.—Articles of incorporation have been filed for the Eddyville Southern Telephone Company with a capital stock of $1,600 by T. F. O'Mara, Robert Wiley, John O'Neal and others.

HILDRETH, NEB.—The Farmers & Merchants Telephone Company has been chartered with a capital stock of $5,000 by Fred Stoker, Willis Neff, W. S. Moor, and others.

WESTFIELD, N. J.—The American Light, Heat & Power Company has filed articles of incorporation with the Secretary of State, with a capital stock of $250,000. The incorporators are G. L. Delatour, G. R. Shepard and Alfred Worsnop.

HARTWICK, N. Y.—Articles of incorporation have been filed for the Susquehanna River Power Company with the Secretary of State. The company is capitalized at $200,000, and the incorporators are Charles A. Greene, Jesse Myers and Thomas Achenbach, of New York.

LEETONIA, OHIO.—The People's Electric Light & Power Company, of this place, has been incorporated with a capital stock of $15,000 by Albert E. Green, A. J. Thompson, J. M. Garfield, E. J. Blandon and F. H. Ginn.

FAIRVIEW, PA.—The Fairview Telephone Company has been incorporated, with a capital stock of $10,000.

RINGTOWN, PA.—The Farmers' Independent Telephone & Telegraph Company has been incorporated with a capital stock of $5,000 to operate a telephone system in Columbia and Schuylkill counties.

SALEM, S. D.—Articles of incorporation have been filed for the Star Telephone Company with a capital stock of $1,500.

SUMMIT, S. D.—The Summit Rural Telephone Company has filed articles of incorporation with a capital stock of $25,000.

ALTAMONT, TENN.—The Citizens' Telephone Company has been incorporated by J. N. Hobbs, R. F. Hobbs, J. R. McCarver and others.

ALONZO, TENN.—The Alonzo Telephone Company has been organized with the following officers: L. R. Bonner, president; George Gauvy, vice-president; A. R. Bonner secretary, and Flora Bickers, treasurer.

CELINA, TENN.—The People's Co-operative Telephone & Switchboard Company has been incorporated by J. T. McColgan, E. S. Dalton, P. M. Moore and others.

DALLAS, TEX.—The North Electric Company has been incorporated with a capital stock of $10,000 by A. A. Mans, L. J. Weaver and George C. Steele.

SEATTLE, WASH.—Articles of incorporation have been filed for the Entait Power Company with the Secretary of State by A. B. Gray, M. D. Marsh and J. H. Allen. The object of the company is to develop the water power of the Entait River. The capital stock of the company is placed at $200,000.

STAR PRAIRIE, WIS.—The Cedar Lake Rural Telephone Company has been incorporated, with a capital stock of $5,000, by Charles A. Pilgrim, A. L. McDonald and A. Sabin.

MILESTONE, SASK., CAN.—The Milestone Farmers' Mutual Telephone Company, No. 3, has been organized here and will build about 30 miles of telephone line to the southwest of here. G. A. Sylte, of Milestone, is secretary.

PERIBONCA, QUE., CAN.—The Broet-Couston Telephone Company has been incorporated. The provisional directors are: T. L. A. Broet, Peribonca, Que.; E. Morel, L. d'Apchier, of Pierrelatte, Que.; B. A. Scott, P. Corriveau, G. F. Gibson, of Quebec.

## Personal.

MR. FRANK McMASTERS, for many years with the Ft. Wayne Electric Company, has recently associated himself with the Northern Electrical Company.

MR. FREDERICK S. MINOT, president of the Goodyear Rubber Insulating Company, is on a visit to Havana, Cuba, in connection with the contest there for the Havana telephone franchise.

MR. LYMAN C. REED has accepted the position of manager of the Electric Manufacturing Company, of New Orleans, La., recently organized for the manufacture of a high-grade line of panel and switchboards, steel boxes, etc.

MR. WILLIAM J. SMITH, of Providence, R. I., who has had charge of the Long Island Sound stations of the Massie Wireless Telegraph Company, has been appointed manager of the Pacific Coast Division, vice Mr. A. A. Isbell, who resigned on Feb. 1.

MR. IVAN RICE, treasurer of The Switchboard Equipment Company, Bethlehem, Pa., has just returned from an extended trip through the West and the Pacific Coast, and reports that he has found the conditions there a contrast to those in the East, as prosperity prevails everywhere along the Coast.

MR. E. C. DEAL, of Hackensack, N. J., who has been in charge of the Bergen County division of the Public Service Corporation for several years, has been transferred to Elizabeth. He will have general supervision of the central division, which comprises all of Union, Middlesex and Somerest counties.

MR. R. D. TOMLINSON.—The Lowell Association of the national order of Stationary Engineers recently held a well attended meeting, when the members were entertained with an illustrated lecture by R. D. Tomlinson, of the Allis-Chalmers works, of Milwaukee. He spoke on general power station work and dealt in an interesting way with his subject. There were present guests from Haverhill, Lawrence, Nashua and Pepperell and Pawtucket, R. I.

MR. ALPHONS WESTEE has been appointed treasurer of the several Edison companies with headquarters in Orange, N. J., to fill the vacancy recently caused by the death, by suicide, of Mr. John F. Randolph. Mr. Westee, who was born in Brooklyn in 1865, entered Mr. Edison's employ as an office boy, and has been auditor of the Edison companies for about 14 years. Mr. Westee will continue to act as secretary and auditor in addition to his new duties.

MR. WM. P. BEAR, now with Kohler Brothers, of Chicago, will go to Duluth about March 1, to assume the position of general manager of the Duluth branch of the Northern Electrical Company. He has been in the electrical business since boyhood, serving in various capacities with W. T. Osborne & Company, of Kansas City, Chicago Edison Company, Illinois Steel Company, Fort Wayne Electric Company, and in his last position with Kohler Brothers. Mr. Bear is a graduate of Armour Institute, having worked his way through that institution and receiving two scholarships in recognition of high standing in all his work. With Kohler Brothers, where he has been for the past three years, he has full charge of all switchboard work for the firm, doing the engineering and directing all switchboard installations, as well as handling the commercial end of the switchboard department.

PROF. C. FRANCIS HARDING, recently appointed head of the electrical engineering department of Purdue University, and director of the electrical laboratory, will take up these duties early in March. Prof. Harding was graduated with the degree of B. S. in Electrical Engineering from Worcester Polytechnic Institute, where he specialized in high-tension transmission work. After spending some time in the testing department of the General Electric Company, at Schenectady, he was for two years electrical engineer of a high-tension interurban electric railway system in New England, and later was for one year electrical engineer for the D. & W. Fuse Company, of Providence, R. I. After serving as manager of the publication department, Fort Wayne Electric Works, he occupied the position of assistant professor of electrical engineering at Cornell University, which position he resigned to become assistant electrical engineer with the Stone & Webster Engineering Corporation. At present he is with the engineering department of the Boston Edison Company.

# Trade Publications.

GAS ENGINES.—Brochure No. 55 of the Weber Gas Engine Company, Kansas City, Mo., is devoted to vertical gas engines and suction gas producer plants.

RECORDING ELECTRICAL INSTRUMENTS.—Bulletin No. 24 of Wm. H. Bristol, 45 Vesey Street, New York, gives a well-illustrated description of recording milli-voltmeters and shunt ammeters.

GATE VALVES for pressures of 150 lb. or 250 lb. per sq. in. are described in detail in a pamphlet recently issued by Jenkins Bros., 71 John Street, New York, as a supplement to their general catalogue.

WEBER GAS ENGINE COMPANY, Kansas City, has issued a brochure on governors that govern, devoted to the proposition that a gas engine can operate an electric generator and ensure steady lights.

ELECTRIC LOCOMOTIVES FOR MINE AND METALLURGICAL WORK.—A reprint issued by the Allgemeine Elektricitaets-Gesellschaft of Mr. A. Soeder's paper, with the above title, read before the Mining Engineers' Society of Upper Silesia.

ELECTRICITY AND PRINTING SHOPS.—An admirably illustrated pamphlet, issued by the Allgemeine Elektricitaets-Gesellschaft, describing many applications of its motors to printing presses, from the small job press to the ponderous Webb presses.

INSULATORS.—Insulator Catalogue No. 1 of the Ohio Brass Company describes a great variety of porcelain insulators, for all voltages. A very complete line for low-tension work includes telephone insulators and electric light and railway feeder insulators.

TRANSFORMERS.—Folder No. 4011 of the Allis-Chalmers Company, Milwaukee, Wis., deals with transformers for lighting service. These transformers, which are designed for operation at a primary e. m. f. of 1050 or 2100 volts, are made in 16 sizes, ranging from 6 k-va to 50 k-va.

ELECTRICAL MEASURING INSTRUMENTS.—The Robert Instrument Company, 56 Shelby St., Detroit, Mich., have issued a catalogue dealing with pocket volt-ammeters, ammeters, voltmeters, miniature and standard size switchboard ammeters and voltmeters, electroplaters' voltmeters and spark-coil current indicators.

SECOND-HAND MACHINERY.—Mr. J. Warren Archer, of 114 Liberty Street, New York, has issued a circular list of electrical and steam machinery. The list includes railway units, rotary converters, transformers, controllers, switchboards, instruments, arc dynamos, direct-current and alternating-current generators and motors, Corliss and automatic steam engines.

FUSE HOLDERS.—The Trumbull Cheer magazinette for February gives illustrations and descriptions of fuse holders made by the Trumbull Electric Manufacturing Company, Plainville, Conn. A large part of the publication is filled with gossip which makes interesting reading. Among the pointed paragraphs is one stating that "Advertising is like a bent pin in the seat of a sleepy man's chair."

PUSH-BUTTON AND LEVER-CONTROLLED ELECTRIC ELEVATORS.—The Allgemeine Elektricitaets-Gesellschaft of Berlin has just issued a well-illustrated pamphlet on its push-button and lever-controlled electric elevators for direct-current and alternating-current circuits. The various parts of the controller mechanism are shown, as well as complete diagrams of electrical connections.

AMERICAN FLAMING ARC LAMP.—The American Flaming Arc Lamp Company, Boston, Mass., has issued a pamphlet descriptive of its new type of flaming arc lamp, known as the Baker-Bartlett system, Mr. J. Gardner Bartlett being president of the company and Mr. Malcolm H. Baker the engineer. The lamp is described and illustrated in full detail, and the concluding pages contain instructions for insulation and operation.

ARC LAMPS.—The Allgemeine Elektricitaets-Gesellschaft has undertaken to rebuild its arc-lamp housings so as to conform to esthetic tastes. Prof. P. Behrens has been engaged for the purpose of designing these housings, and the first lamp after his design is shown in a four-page pamphlet. The lamp is shown in colors and its simple and graceful lines give it a dignity that cannot be approached by the tawdry affairs one so often sees.

ELECTRIC WASH DAY is the title of a neat and interesting pamphlet issued by the "1900" Washer Company, of Binghamton, N. Y. It is devoted to their electric washers and wringers, which are both driven by electric motor and have been designed for such method of operation. A large number of these are already connected to electric light circuits throughout the country, both direct and alternating. Both appliances embody a number of good points quite aside from their electrical operation.

STATISTICAL TABLES.—Spencer Trask & Co., investment bankers, William and Pine Streets, New York City, have issued the 1908 edition of their booklet entitled "Statistical Tables." The current edition comprises 84 pages of information relating to American railroad and industrial companies, together with details covering practically all of the securities dealt in upon the New York Stock Exchange. Information is given upon the bonds of street railway, gas, electric light and industrial companies.

PORTABLE AND PRECISION METERS.—Circular No. 1104, of the Westinghouse Electric & Manufacturing Company, covers the entire line of portable meters manufactured by the company. Technical description of the principles upon which these meters operate will be found of much interest to users of portable ammeters, voltmeters, watt-meters and watt-hour meters, and the diagrams of connections illustrating the various methods of testing single-phase and polyphase circuits will prove useful to those called upon to make such measurements.

ELECTRICITY IN PAPER MAKING.—This is a pamphlet, commendable for the beauty of its execution, describing the Allgemeine Elektricitaets-Gesellschaft's systems of motor control in connection with motors driving paper-making machinery. The speed of a paper-making machine must be capable of variation over a considerable range and the variation must be made in small increments. Two control systems are described; in one a booster is used to increase or decrease the potential of the driving motor circuit; the other is that devised by Mr. Ward Leonard. Electric circuit connections for both systems are given.

COMPOUND ENGINES.—Bulletin No. 1512, of the Allis-Chalmers Company, has for its subject compound Reynolds-Corliss engines. Information on the building of compound engines is included from the first one, known as the famous "Centennial" engine, to those recognized today as embodying in their design and construction the very highest development of the engine builder's art. To determine whether it is better to use a compound engine requires careful consideration of the commercial and engineering conditions in each particular case, and to know how to meet these conditions is described in this bulletin.

TELEPHONE APPARATUS.—The Western Electric Company, of Chicago and New York, has just issued a very complete and informational catalogue devoted entirely to its telephonic apparatus. It is a quarto of 170 pages and contains only apparatus in common, general use, it being stated that material for which there is very little demand, or which is furnished only with complex exchange equipments, is omitted. It includes complete telephone sets, switchboards, batteries, insulators, induction coils, jacks, plugs and keys, protectors, bells, switches and supplies generally. All are shown in profusion and in detail, and there is a large amount of descriptive text, as well as list prices in every instance. This catalogue is one of the first actual evidences of the new trade policy of the Western Electric Company in selling its Bell apparatus to all comers.

POLYPHASE INDUCTION MOTORS.—The many advantages of alternating current as a source of power in the operation of manufacturing plants are now being fully recognized. Allis-Chalmers Company will send to any one interested a copy of its bulletin No. 1040, entitled "Polyphase Induction Motors." The induction motor is very simple in construction and, without moving contacts of any kind, insuring absolute freedom from sparking, flashing or burning, which is essential in plants where combustible material is at hand. The voltage in the rotating part is so low that insulation breakdowns do not occur. Allis-Chalmers Company manufactures induction motors of two types. One has a rotor with "squirrel cage" winding and is suitable for all classes of constant speed service. The other type is provided with a wound rotor adapted to the insertion of resistance at starting or for obtaining variable speed.

CARBON BREAK CIRCUIT BREAKERS.—An important feature of all electrical installations is the circuit breaker. In Bulletin No. 4550 the General Electric Company, Schenectady, N. Y., describes a number of its well-known lines. Type C, Form G circuit breakers are designed for a small, reliable, automatic, protective device for direct and alternating current systems at a moderate price. Type C, Form P are particularly adapted for use on railway and power systems which are frequently subjected to severe short circuits and heavy overload. They are made up to 12,000 ampere capacity. Type C, Form K, especially designed for heavy service, are particularly well suited for railway work. They are made in capacities up to 10,000 amperes. The bulletin also contains descriptions of auxiliary switches, automatic tripping devices, etc., to be used with the circuit breakers, and gives complete data as to capacities, prices and dimensions of the devices shown. The bulletin contains thirty-six pages and is conveniently arranged for reference.

BOILER SCALE.—"What Scale Does to Boilers and What Is Gained by Keeping It Out of Them" is the title of a pamphlet published by the Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia, Pa. It is sent free on request. The unexpected demand for copies of this treatise has made necessary a second edition, which is now being distributed. The information here presented will be of interest and value to anyone concerned in the design, management or operation of steam boiler plants. The data have been gathered from the reports of the boiler inspection and insurance companies, the recent experiments of Prof. Schmidt at the University of Illinois, the results reported by railroads and power plants and from various authorities and seem to show that by reason of scale the average boiler plant wastes from 5 to 15 per cent of all the coal consumed, while the loss from boiler cleaning and repairs, loss of service and shortened life is even greater. This book will be sent by the publishers upon request.

MILL MOTORS.—Mill type motors manufactured by the General Electric Company, Schenectady, N. Y., to meet the demand of the constantly increasing business done for electrically driven rolling mills, etc., are described in Bulletin No. 4562, recently issued by the company. These motors are manufactured for direct and alternating current and are designated MD and MI motors, respectively. They are built in sizes from 30 to 150 hp, and the direct current motors, while generally rated at 220 volts, can be supplied for 500 volts, with a slight variation from standard speed. The alternating-current motors are wound for either 220 or 440 volts, 25 cycles, three-phase. The illustrations in the bulletin show the particularly heavy construction, and dimension diagrams,

with other data, are given in the text. The motors are totally inclosed, dustproof and are intended for use on heavy and intermittent loads. Mechanically and electrically strong, they are suitable for operating rolling mills, hoists, turntables, conveying machinery, etc.

DIRECT-CURRENT FANS are discussed in an artistic catalogue recently issued by the Peerless Electric Company, Warren, Ohio. Desk, bracket oscillating, ceiling, column and ventilating fans are listed and described.

INDUSTRIAL RAILWAYS.—Booklet No. 075, of the C. W. Hunt Company, 45 Broadway, New York, is a well-illustrated pocket-size publication, containing 64 pages devoted to industrial railways. In the Hunt system the flanges of the wheels are placed on the outside, and the outer rail around each curve is built so that the wheel will run on the flange instead of the tread. All curves are built for a common radius of 12 ft., around which the cars will travel as easily as on a tangent.

FIXTURES.—R. Williamson & Company, manufacturers of electric and combination fixtures, Chicago, have just issued a supplement to their well-known catalogue No. 12, which has been a standard fixture reference catalogue in the hands of central stations and electrical supply dealers the country over for a number of years. This supplement brings the catalogue up to date by showing square, mission and colonial styles designed since it was published. It contains 67 pages of handsomely engraved plates, showing modern fixture designs. One commendable feature of the catalogue is that all the fixture illustrations are made to one-quarter scale. Another commendable feature of design shown in this supplement is the tendency to place lamp sockets pendant and abandon the old-fashioned designs with sockets at an angle, which were usually bad, both from an illuminating and a mechanical standpoint. The catalogue also includes full-sized illustrations and prices of solid brass chain kept in stock for the manufacture of designs to order.

BOILER FEED WATER.—"Where water and fuel are scarce or dear" is the title of an interesting circular treating of the heating and purifying of boiler feed water in mining and smelting plants. The pamphlet is published by the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa., and shows that by means of a Cochrane heater, about 6½ lbs. of water may be heated from 60 to 210° F. by 1-lb. of exhaust steam, and further than the 1-lb. of steam will be condensed and added to the boiler feed as pure distilled water, thereby saving 16 per cent of the coal bill as well as a nearly equal proportion of raw water. Further, heating the water throws out of solution the bi-carbonate of lime and magnesia, which, along with mud, sand and other impurities, are precipitated in the heater instead of being carried over into the boiler. It is pointed out that as the heater does part of the work of the boilers, six boilers and a Cochrane heater can make more steam, while requiring less fuel, less labor and less water, than seven without one. This pamphlet will be of interest to all who own or operate boiler plants.

CALIFORNIA HYDRO-ELECTRIC PLANT.—Allis-Chalmers Company's Bulletin No. 2027, entitled "The Hydro-electric Plant at Trinity River, California," contains some information on an interesting power transmission system. This plant is one of those which have been constructed with an eye to the future rather than the present needs of the communities they serve. It is located in the central part of Trinity County, California, two miles below the town of Junction City, where Cañon Creek, from which the water used for power is obtained, flows into the Trinity River, having a drainage area of 52 square miles. The dam, which is small, serves merely for diverting the water. Alternating sections of ditch and open flumes, with a total length of 5250 feet and a tunnel 1821 feet long are comprised in the system. An effective head of 600 feet, or working pressure of 260 lbs. per square inch, is obtained from two penstocks, each 1165 feet long. This power house is equipped with Allis-Chalmers electrical machinery, consisting of two three-phase, 25-cycle generators; each 750-kw, 500 r. p. m., 2200-volt, seven step-up transformers and auxiliary apparatus. The description of the entire plant is quite complete and will be found of interest.

GENERAL ELECTRIC RAILWAY CONTROLLERS.—The use of higher operating voltages for electric railway systems has imposed more exacting operating conditions on the controller equipments of electric cars. The General Electric Company, Schenectady, N. Y., has designed a new line of cylinder controllers with improved magnetic blowouts, which can be used on systems on which the voltage peaks reach 750 volts. At present three controllers, known as the K-34, K-35 and K-36, are being built and are described in Bulletin No. 4557, recently issued. The K-34 controller is suitable for use with either two 150-hp or four 75-hp motors, the K-35 with either two 100-hp or four 50-hp, and the K-36 with two motors only, each of 60 hp or less. The K-34 and K-35 controllers are provided with bridge connections and maintain full current through all motors during the transition period from series to parallel, giving a smooth acceleration and reducing the strain on motors and gearing. A powerful magnetic field is produced by means of individual blowout coils and arc chutes, which insures the extinction of the arc under all operating conditions and reduces the burning and repairs to a minimum. The bulletin gives the details of construction and dimensions of the different controllers.

ELECTRIC DRIVE IN CEMENT PLANTS.—The manufacture of Portland cement has several features which differentiate it commercially from almost any industry and which make it a particularly suitable field for the introduction of the electric motor. The General Electric Company, Schenectady, N. Y., in Bulletin No. 4555 describes the application of electricity to cement plants and gives a large amount of information regarding the different processes and the apparatus used. A cement plant is kept in practically continuous production, and the shutting down of any one machine must not affect the operation of the others. The direction and distance of the power transmission should not interfere with the most efficient layout, which should be determined solely by the relative location of the quarries, the storage bins, the best available place for the machinery and the space available for future growth. It is necessary to start the machines under overload and provide for short overloads during operation, so that the driving power must give the best efficiency at normal loads, with a large margin of overload capacity. To the above is added the most severe service conditions, on account of the unskilled labor employed and the character of the material manufactured. The bulletin points out the reasons why the General Electric equipment will successfully meet the requirements. A list of cement plants using General Electric apparatus gives a number of the equipments already installed.

DIRECT-CURRENT MOTOR STARTING.—Reliable and efficient starting devices are necessary for the satisfactory operation of all motor installations. In Bulletin No. 4559, the General Electric Company, Schenectady, N. Y., describes motor starting rheostats and panels for direct current. The rheostats contain an improved enclosed type resistance unit consisting of a low temperature coefficient resistance wire wound on a strong tube that is not brittle. The unit is treated with a special compound, which forms a coating both inside and out, making a strong and solid construction, and it is thoroughly baked before being placed in the rheostat. Rheostats with no-voltage release and those with both no-voltage and overload release are illustrated and described, as well as rheostats for starting reversible shunt or compound wound constant speed motors. In order to facilitate the installation of motor starting devices, the General Electric Company has perfected a line of motor starting panels, in which there is no multiplicity of the terminals to give trouble from bad or incorrect connections; space, labor and time are saved; maintenance is reduced and satisfactory operation, immediate and permanent, is obtained. The bulletin shows a variety of these panels in which different types of starting rheostats are used, the rheostat being combined with a line switch and fuses or with a double-pole circuit breaker. Dimension diagrams for the different capacities of rheostats and panels are included.

## *Unclassified Items.*

BALTIMORE, MD.—At the annual meeting of the Maryland Telephone Company the following-named officers were elected: F. H. Bethell, president; C. E. Bryan, vice-president and general manager, and A. P. Crenshaw, secretary and treasurer. The company was recently taken over by the Chesapeake & Potomac Telephone Company, but will continue to operate separately for the present.

DANVILLE, ARK.—The question of establishing an electric light plant here is under consideration. A. Pace is interested in the enterprise.

WOLVERINE, MICH.—B. F. Stiffer, of Birmingham, who holds the electric lighting franchise, is making arrangements to begin operations at once.

GALT, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission for a contract for 600 horse-power, the price not to exceed $22 per horse-power per year. The Council contemplates purchasing the distributing system of the local lighting company.

WALLACE, IDAHO.—The Interstate Telephone Company contemplates establishing an exchange in this city at a cost of about $30,000. The company will also erect three copper circuits between Spokane and Wallace.

ALLENTOWN, PA.—The Consolidated Telephone Companies of Pennsylvania has filed a notice with the Secretary of State of an increase of its indebtedness to the extent of $2,292,900.

GREEN JUNCTION, IOWA.—The Greene County Telephone Company is contemplating rebuilding its telephone exchange.

FORT WORTH, TEX.—Bids will be received until April 7 by J. J. Nunnally, city auditor, for a 650-kw, three-phase, 60-cycle, 2300-volt, alternating current generator with exciter; ten 100-light transformers; switchboard for 20 circuits of 50 arc lamps each; panels, exciter and generator panel, each panel to be equipped with ammeter, voltmeter, switch and fuses; generator to be direct connected to compound condensing Corliss engine. Alternate proposal will be received for 325-kw generator, exciter, engine, transformers and switchboards for ten circuits. Bids must include cost of foundation, delivery and erection of machinery on same. Bids will also be received at the same time for 1200-cp, 6.6 ampere, alternating-current series arc lamps, complete with inner and outer globes for street lighting. Bids may be submitted on lots of 250, 500 and 750 lamps.

SAN ANTONIO, TEX.—The City Council is considering an ordinance requiring all telegraph and telephone wires to be placed underground in the business section of the city.

DECORAH, IOWA.—The Upper Iowa Power Company is contemplating the erection of a new dam, power house and transmission lines to increase the output of its hydro-electric plant. W. H. Burtis is president and manager.

PELLSTON, MICH.—Plans are being prepared by the Pellston Electric Company for the construction of another dam and power house and about 20 miles of transmission lines. F. E. Hatch is manager.

MR. N. C. WATTS, general manager of the Staunton Mutual Telephone Company, of Staunton, Va., has been elected president of the Virginia & Tennessee Telephone Company, of Roanoke, Va.

## Business Notes.

THE EASTERN ELECTRICAL ENGINEERING COMPANY, of Milford, N. H., has opened a branch in Bangor, Maine, in charge of W. E. Billings, treasurer and general manager of the company.

THE INTERNATIONAL STEAM PUMP COMPANY has moved its offices from 114 Liberty Street to 115 Broadway. The repair shops of Henry R. Worthington, the Geo. F. Blake Manufacturing Company, Knowles Steam Pump Works, the Laidlaw-Dunn-Gordon Company, the Slayton Air Compressor Works, the Snow Steam Pump Works, Holly Manufacturing Company and the Deane Steam Pump Company will be located at 44 Trinity Place, New York City.

DOSSERT & COMPANY are making further large shipments of their solderless two-way connectors to be used in the wiring of the eighty-five steel passenger cars now being completed by the Pressed Steel Car Company at McKees Rocks, Pa., for the Pennsylvania Railroad. These cars will run on the main line between New York and Chicago. They will be electrically lighted and no solder will be used in the splicing. The Dossert joints are installed in junction boxes underneath the car floors where the No. 4-0 feeder cables are connected.

MR. H. F. COPELAND, for twelve years manager of the electrical department of James S. Barron & Company, has established offices at 203 West Broadway, New York, as agent for a number of specialties for telephone and telegraph construction and maintenance. He will also manufacture and market the H-P rustless cable hanger. Among the specialties that will be handled are "Glitterine," two-hole telegraph blocks, wood battens, wood wiring cleats, ebonite and specialties in wood and in sheet metal for telephone and telegraph construction and maintenance. He will also handle various other devices.

LARGE ELECTRICAL MACHINES.—Several months ago steps were taken to stock and equip two of the great machine shop units at the West Allis Works, of Allis-Chalmers Company, known as shops 5 and 6, for the building of large electrical machines, particularly those intended for direct connection to the various forms of prime movers which constitute a large part of the product of the company. Heretofore the large electric generators for driving by gas engine, steam turbine, water wheel or Corliss engine have been built exclusively at the company's works in Cincinnati, Ohio. The construction of a part of these large machines in Milwaukee gives much needed room for the manufacture of motors, transformers and small generators at Cincinnati and does away with the former necessity of shipping heavy engine shafts to the electrical works to be fitted and keyed to the rotors of engine type generators. On the other hand, the West Allis Works are better equipped, through large experience in the building of big equipments, to handle the heavy parts. To indicate the type of work which has already been turned out at West Allis, shipment was recently made of two 2000-kw, 660-volt, 25-cycle, 3-phase alternators which were sent to the Homestead Works of the Carnegie Steel Company. These alternators are for direct connection to 42 x 54-in. Allis-Chalmers twin tandem gas engines, also products of the West Allis Works. A third alternator was recently shipped to the central furnaces of the American Steel & Wire Company. This machine was a 1000-kw, 13,200-volt, 25-cycle, 3-phase unit, designed for direct connection to a 34 x 42-in. Allis-Chalmers gas engine. These three generators were the first to be completed and shipped from the new shops, and others, including a 6500-kw unit, will follow in rapid succession during the next few weeks.

# Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 18, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

879,138. RAILWAY SIGNALING DEVICE; Frederick Bauer, New York, N. Y. App. filed Oct. 18, 1907. Railway signaling device adapted to indicate the presence of a train at track sections adjacent to a crossing so as to prevent a collision thereat.

879,158. TRANSFORMER; Charles LeG. Fortescue, Wilkinsburg, Pa. App. filed June 8, 1907. Provides means whereby a large variety of voltages may be obtained from a transformer by employing a comparatively small number of leads and without appreciable unbalancing of the magnetic circuits.

879,168. ELECTRIC RAILWAY SIGNAL; Frederic M. Hill and William C. Davis, Columbus, Ohio. App. filed April 6, 1907. Has a pivoted indicating device with a rotatable disk and a hook member engaged by a magnet trip to turn said disk and raise the semaphore signal.

879,180. ARC LAMP; Oskar Konitzer, Munich, Germany. App. filed Jan. 19, 1906. Patentee has a carbon rod with a longitudinal duct or cavity eccentric therein so as to provide a very thin web or wall at one point. This wall is engaged by a stop of the type ordinarily used in flaming arcs.

879,234. ELECTRIC CIRCUIT CONTROLLER; Christian Aalborg, Wilkinsburg, Pa. App. filed April 4, 1906. Circuit controllers for effecting suitable circuit connections for starting and stopping electric motors of the induction type. Makes use of depressible plungers in an oil bath.

879,245. CONTACT FINGER; William Cooper, Pittsburg, Pa. App. filed May 21, 1906. A spring contact finger for controllers comprising a V-shaped resilient member, one leg of which has a hook at its end to engage the other leg, the other leg carrying a contact block.

879,246. COMMUTATOR FOR ELECTRIC APPARATUS; Frederick W. Cox, Wilkinsburg, Pa. App. filed April 4, 1906. A means for clamping the commutator segments securely in place, comprising undercut collars engaging the segments at the ends and middle portions thereof.

879,252. MULTIPLE RATIO TRANSFORMER; Charles LeG. Fortescue, Wilkinsburg, Pa. App. filed June 8, 1907. Electrical transformer in which the winding is arranged to secure a large number of ratios between the voltages of the primary and secondary windings so that the adjustment of the voltage ratio may be effective without unbalancing the magnetic circuits, or materially affecting the inductance and the power factor of the transformer.

879,257. TROLLEY CATCHER AND RETRIEVER; Franklin J. Gustine, New Orleans, La. App. filed July 5, 1906. Provides means whereby the trolley pole is automatically tripped at a certain position in its upward movement so as to fall by gravity below its normal position of use.

879,267. CONTROLLING MEANS FOR PNEUMATICALLY OPERATED DEVICES; Ray P. Jackson, Wilkinsburg, Pa. App. filed March 3, 1906. Construction of overhead collector or shoe of the double-jointed arm type, having pneumatic retrieving and controlling apparatus.

879,274. FRICTION COUPLING OR CLUTCH; Christian Kramer, Frankfort-on-the-Main, Germany. App. filed Jan. 25, 1907. Magnetic friction clutch having a non-metallic body loosely mounted between the driving and driven members and establishing a friction, connection therebetween, but preventing their engagement by residual magnetism.

879,285. AUTOMATIC MULTIPLE FUSE BLOCK; William C. Mayo and John Houlehan, El Paso, Tex. App. filed May 2, 1907. Means for inserting fuses in a circuit after any one is blown. Includes a step-by-step ratchet operated mechanism.

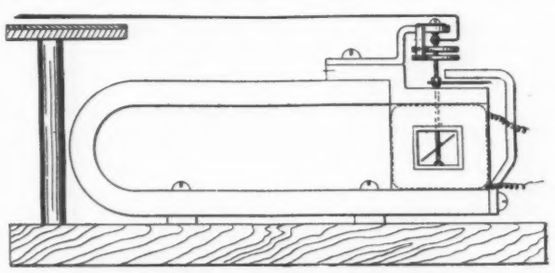
879,300. TELEGRAPH SWITCHBOARD; Albert T. Newman, Greeley, Kan. App. filed March 6, 1907. Switchboard adapted for use by telegraph operators, in which one man frequently has a number of instruments to look after. Has a pivot arm movable over a circular series of contacts for the different instruments.

879,307. SYSTEM OF ELECTRICAL DISTRIBUTION; Roderick M. Palmer, Cambridge, Mass. App. filed March 17, 1906. Has means whereby a plurality of translating devices may be individually or conjointly operated by a current of relatively high voltage, and the circuit of the said devices individually controlled so that one of the translating devices may be operated or a plurality may be simultaneously operated as desired.

879,357. TELEGRAPHIC TRANSMITTER; Clarence Brain, Parsons, Kan. App. filed May 15, 1907. Telegraphic transmitter of the automatic type in which the depression of keys operates mechanism or devices for transmitting Morse signals.

879,361. BATTERY PLATE; William M. Brodie, West Orange, N. J. App. filed Feb. 15, 1905. As a new article of manufacture, a strongly coherent, pressed copper oxid plate having corrugations formed therein of such depth as to materially increase the superficial area thereof, substantially as set forth.

879,385. ELECTRICAL MEASURING INSTRUMENT; Adrian H. Hoyt, Penacook, N. H. App. filed July 9, 1904. Has a pivoted inclined element, means for polarizing said element, mechanical means



879,385.—Electrical Measuring Instrument.

tending to hold said element in a fixed position, a coil for causing deflection of said element, and a pointer for indicating the amount of deflection.

879,387. AMMUNITION HOIST CONTROL; John D. Ihlder, New York, N. Y. App. filed Aug. 30, 1907. Ammunition hoist provided with means whereby it may be stopped at different positions corresponding to different elevations of the gun.

879,397. AIR BRAKE, LIGHTING AND SIGNALING SYSTEM FOR RAILWAY TRAINS; William C. Mayo and John Houlehan, El Paso, Tex. App. filed Jan. 31, 1907. Relates to improvements in the electric control of the braking mechanism of railway trains and the lighting of said trains and also the signaling between the train crew and the engineer.

879,409. WIRELESS TELEGRAPHY; George W. Pierce, Cambridge, Mass. App. filed March 16, 1906. Apparatus at the receiving station of a wireless telegraph system designed to be readily tuned or brought into resonance with electromagnetic waves of widely varying length and in which variable resonance may be attained.

879,411. SELF-WINDING CLOCK; Henry S. Prentiss, Elizabeth, N. J. App. filed Sept. 14, 1906. Self-winding clock of the type having a weighted arm which is intermittently raised by an electromagnet and which impels the clock train through a ratchet wheel.

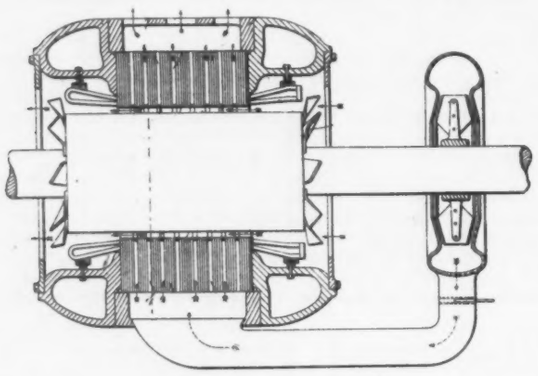
879,425. ELECTRIC GENERATOR FOR TELEPHONE LINES; Henry Tideman, Menominee, Mich. App. filed Jan. 16, 1905. In a commutator for magneto electric generators, two semi-circular segments of which the joint periphery forms a circle about a shaft, two

conducting circular segments having a reduced diameter through half of the circumference, and an insulating circular segment of similarly reduced diameter through the half circumference, embraced between said two conducting circular segments, substantially as described.

879,438. TELEPHONY; Morgan Brooks, Urbana, Ill. App. filed May 31, 1906. In a substation telephone set, the combination of line conductors, a transmitter, a receiver and induction coils, said receiver being connected with a plurality of said induction coils and said line conductors being connected with but one of said induction coils, substantially as described.

879,452. PROCESS OF MAKING MOLTEN PEROXIDS; Hans Foersterling, et al., Perth Amboy, N. J. App. filed March 6, 1907. A process of making molten alkaline oxids which consists in bringing the metal to be oxidized into reaction with an oxidizing agent at such a temperature that the resulting oxid is instantly molten.

879,454. TELEPHONE EXCHANGE APPARATUS; William A. Fricke, Chicago, Ill. App. filed March 8, 1907. A telephone exchange system including a plurality of telephone lines extending from substations to an exchange, line and cut-off relay circuits, condensers for separating said circuits, and connecting means at the exchange permanently associated with said condensers and adapted to connect said condensers in talking sides of the telephone line and between the relays in said circuits.



879,564.—Turbo-Alternator.

879,494. TRAIN PROTECTION FOR RAILWAYS; Benton C. Rowell, Chicago, Ill. App. filed Feb. 13, 1899. Relates to signal and train stop system for railway crossings designed to make it impossible for two cars to collide at said crossing.

879,498. ELECTRICAL WATER HEATER; Milton H. Shoenberg, San Francisco, Cal. App. filed June 5, 1907. Has a dome-shaped chamber in which the water circulates and which contains a plurality of spirally hung resistance elements which the current traverses in a multiple circuit.

879,522. LIGHTNING ARRESTER; George W. Clark, Grand Rapids, Mich. App. filed April 26, 1907. Patentee has a pair of carbon blocks separated by minute gap and a magnet with depending poles arranged to blow out any arc which may be formed.

879,532. SPACE TELEGRAPHY; Lee DeForest, New York, N. Y. App. filed Jan. 29, 1907. Oscillation detector comprising an evacuated vessel having two electrodes enclosed therein, and means for heating one of said electrodes. A plate of platinum is interposed between the electrodes.

879,548. SIGNALING APPARATUS; Jewet G. Homet, Scranton, Pa. App. filed Oct. 8, 1907. Patentee provides a plurality of depending arms in the path of the car which are engaged in a predetermined order so as to light certain lamps in a definite sequence, the character of which gives predetermined warnings.

879,555. INCANDESCENT LAMP CONTROL; Roy E. Kimball, Fruitvale, Cal. App. filed March 30, 1906. Provides means by which an incandescent lamp may be lighted or extinguished by a distant switch independently of the local switch and regardless of the position thereof.

879,564. TURBO-ALTERNATOR; Charles E. Lord, Norwood, Ohio. App. filed June 7, 1905. The stationary field frame has passages therethrough which co-operate with ventilating passages in the armature so as to provide a continuous ventilating current.

879,568. BURGLAR ALARM; James E. Murray, Washington, Pa. App. filed Feb. 1, 1907. Circuit closing device making use of a rod which is supported transversely of the window so as to be raised, and open or close a circuit when the window is disturbed.

879,582. TROLLEY RETRIEVER; Richard Phillips, Washington, D. C. App. filed June 8, 1906. Trolley harp carries wing-shaped pivoted arms which have gear connections with the trolley pole so as to be raised or lowered automatically.

879,586. CABLE HANGER; DeElbert A. Reynolds, New York, N. Y. App. filed Sept. 7, 1906. Patentee surrounds the usual connection wires of a messenger cable with sheet metal parts which prevent injury to the cable suspended.

579,593. TROLLEY WHEEL; Jacob M. Siegrist, Oswego, N. Y. App. filed Sept. 4, 1907. Trolley wheel of the type having spirally arranged grooves adjacent to the main groove of the wheel so as to guide the conductor thereon. Has special supporting means by which the wheel is removable, and lubricating features.

879,596. RECLAIMING TIN-SCRAP; Elmer A. Sperry, Brooklyn, N. Y. App. filed Oct. 8, 1906, The method of reclaiming tin-scrap, which consists in concentrating the tin values, removing the black scrap therefrom, submerging the tin concentrate in an anhydrous liquid and treating the same with chlorin.

879,612. ALKALINE STORAGE BATTERY; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed June 29, 1904. In a storage battery, the combination with suitable active materials, of a practically non-foaming alkaline electrolyte obtained by filtration of an alkaline solution through a filtering medium of very fine porosity, substantially as set forth.

879,632. CIGAR LIGHTER; Augustus C. Gruhlke, Waterloo, Ind. App. filed June 13, 1906. Cigar lighter of the type which employs a volatile fluid and is electrically ignited when it is desired to use them. Has a contact which is passed across the plate adjacent to the wick when desired.

879,633. PROCESS OF TREATING METALLIC ORES OR MATTES; Emil Gunther, et al., Eisleben, Germany. App. filed June 18, 1907. Subjects copper and nickel containing concentrated regulus to electrolytic action, as anode in bath of chlorid of copper.

879,636. TROLLEY WHEEL; Edward J. Harrison, South Bend, Ind. App. filed July 18, 1907. The trolley wheel is made with hollow spokes which communicate with an oil cup within the wheel so as to lubricate the peripheral groove where it engages the conductor.

879,643. TELEPHONE CIRCUIT; Charles M. Jacobs, et al., Reading, England. App. filed Oct. 12, 1906. In a system for eliminating or reducing the influence of disturbing currents on telephone circuits, the combination of a telephone transformer and a phonoporically wound receiver, the latter being connected across the terminals of the secondary winding of the transformer, the said secondary winding being directly in the line.

879,648. MEANS FOR AUTOMATICALLY CLOSING ELECTRIC CIRCUITS; Fayette W. Keeler, Temple, Tex. App. filed Aug. 18, 1906. A signal system designed to permit a train despatcher to communicate with all the operators at once in a division, as well as selectively ring alarm bells at particular stations.

879,650. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed May 14, 1906. Provides means whereby telegraph instruments may be protected from the inductive influence of neighboring wires.

879,651. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 26, 1907. Means for eliminating or counteracting the inducing effect of wires carrying current for light or power or wires useful for electric transmission of intelligence.

879,683. PROTECTOR FOR THIRD RAILS; Frank D. Sharp, Altoona, Pa. App. filed Jan. 19, 1907. The third rail is held in inverted relation between insulating blocks inserted in spaced cast-iron supports on the exterior of which are bolted a protecting cover of wooden boards.

879,697. ELECTRIC CLOCK-WINDING MECHANISM; Adolf Trilke, Eimsbüttel, near Hamburg, Germany. App. filed Dec. 21, 1905. Electric winding device for combined clock and wheel trains designed to enable the winding of the clock trains, one of which may be the going train and the other the striking train, and each operated by a weighted lever.

879,711. TELEGRAPHIC TRANSMITTER; Clyde William, Porter B. Mitchell and Sharpe Hathaway, Barton, Ohio. App. filed May 6, 1907. Provides means whereby a succession of Morse signals may be automatically sent so as to relieve the operator of as much unnecessary physical work as possible.

879,723. ATTACHMENT PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed Jan. 29, 1904. A lock or stop for retaining a plug attachment in position in the socket and in firm electrical contact therewith to prevent the plug from becoming partially detached with the consequent arcing between the contacts.

879,724. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Feb. 29, 1904. Provides means whereby the usual cap having an opening therethrough for the leading-in wires and an insulating bushing in said opening is entirely done away with.

879,725. ATTACHMENT PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed March 25, 1907. Attachment plug having a base with a plug movable relatively thereto, and an outer contact member carried by the base and adapted to be expanded by the movement of said plug relatively to said base.

879,729. TROLLEY POLE HEAD; George G. Buchanan, Dubois, Pa. App. filed April 21, 1906. The trolley harp is pivoted on a vertical axis so as to swing laterally at the upper extremity of the trolley pole. Spring abutments are provided to limit the lateral movement.

879,760. SWITCH PLUG; Henry C. Froelich, Chicago, Ill. App. filed Aug. 12, 1903. Plug adapted to be inserted into sockets of the ordinary screw-threaded type without necessitating the usual turning manipulation. The plug is adapted to be slipped in and out in the manner of a telephone jack plug.

879,765. SUPPORT FOR ELECTRIC SERVICE WIRES AND CABLES; Edward H. Greenleaf and Theodore A. Dissel, Newburgh, N. Y. App. filed July 23, 1907. A wire hanger of special construction having a portion to engage the messenger wire and a depending hook to engage the main conductor. Has supplemental hooks to carry additional service wires.

879,819.—Electric Lamp Socket.

879,773. EXTENSION PLUG FOR ELECTRIC LIGHTS; Bryson D. Horton, Detroit, Mich. App. filed Oct. 2, 1903. Extension couplings for conductors of electric currents. Designed to be inserted and removed without the usual twisting movement.

879,777. ELECTROMEDICAL APPLIANCE; Samuel H. Lackland, St. Louis, Mo. App. filed April 22, 1907. Has a belt with electrodes in circuit with a small dry battery which is adapted to be worn or carried by the patient.

879,789. REGULATING MAGNET CONTROLLER FOR ELECTRIC ELEVATORS; Henry P. McColl, Hawthorn, Victoria, Australia. App. filed May 29, 1906. A regulating magnet controller comprising a rheostat actuated by solenoids having windings with opposite influences, said windings being controlled by the car switch so that acceleration of the motor may be sustained at any speed by the operation of said switch.

879,819. ELECTRIC LAMP SOCKET; Gilbert W. Goodridge, Bridgeport, Conn. App. filed July 18, 1907. An electric lamp socket having the end of the shell provided with projections and having a cap flange provided with a greater number of symmetrically arranged openings with which the projections of the shell can engage.

879,824. LIGHTING ATTACHMENT FOR GAS AND ACETYLENE BURNERS; Clifford J. Larkin, Everett, Mass. App. filed Aug. 10, 1907. Lighting attachment adapted to be readily applied to the barrel of any burner connected with any usual supply of illuminating gas or acetylene.

879,830. ATTACHMENT PLUG; David L. Webb, New York, N. Y. App. filed April 16, 1903. An attachment plug adapted to be inserted and removed in a threaded socket without any necessity of turning or twisting the same.